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Vol. CXXXIII.—No. 3449] LONDON: FRIDAY EVENING, FEBRUARY 3, 1922 [PRICE { WITH INDIA AND OTHER SUPPLEMENT } 1s. 6d. BY INLAND POST 1s. 9d.

PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of:—
FERRULES, STEEL.
BUFFERS, DRAW-BAR HOOKS, TRUSS BARS, &c.

Forms of Tender may be obtained from the Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Tuesday, the 28th February, 1922.

T. RYAN,
7314 Director-General.

Civil Engineer Required by the GOVERNMENT of CEYLON for service as an ASSISTANT ENGINEER in the RAILWAY CONSTRUCTION DEPARTMENT for three years, with possible extension. Salary seven thousand rupees per annum, plus a temporary allowance of 33 1-3 per cent. (not to exceed £1,50 per annum). Free passages.

Candidates, unmarried, under 25, should have received good training and experience on an English or American railway and have a thorough knowledge of surveying, levelling, estimating, setting out, and supervising all works in connection with the location and construction of a railway.—Apply at once, in writing, giving age and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Ceylon 11,290.

7345

Ashton-under-Lyne Corporation.
ELECTRICITY DEPARTMENT.

The Electricity Committee invite TENDERS for additional CIRCULATING WATER PIPES and VALVES and EXHAUST STEAM PIPE.

Copies of the specification and form of Tender can be obtained from the Borough Electrical Engineer, Wellington-road, Ashton-under-Lyne, on payment of deposit of £1 1s., which will be returned on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Electricity Works Extensions, Section No. 8" addressed to the undersigned, must be received not later than Twelve Noon on Wednesday, 22nd February, 1922.

By Order,
E. N. O'HARA,
Borough Treasurer.

Town Hall, Ashton-under-Lyne.
30th January, 1922. 7307

Bombay, Baroda, and Central INDIA RAILWAY CO.

The Directors are prepared to receive up to Noon on Friday, 24th February, TENDERS for the SUPPLY of—

GIRDER BRIDGES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices, The White Mansion,
91, Petty France,
Westminster, S.W. 1.
1.2.22. 7354

Bombay, Baroda, and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 17th February, TENDERS for the SUPPLY of—

HELICAL SPRINGS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion,
91, Petty France,
Westminster, S.W. 1,
27.1.22. 7306

City of Hull.
SUPPLY OF TRAMWAY RAILS.

The Corporation are prepared to receive TENDERS for 500 TONS, or alternatively 1000 TONS, GIRDER TRAMWAY RAILS of the special Hull centre groove section, weighing approximately 112 lb. per yard.

Forms of Tender and other particulars may be obtained from the undersigned, free of charge, by actual manufacturers or their accredited representatives.

Tenders, endorsed "Tender for Rails," are to be addressed to the Chairman of the Tramways Committee, and delivered at the Town Clerk's Office, Hull, before Noon on Monday, the 20th February.

The Corporation do not bind themselves to accept the lowest or any Tender.

By Order,
F. W. BRICKNELL,
City Engineer.

Guildhall, Hull,
2nd February, 1922. 7319

Corporation of Durban, Natal.
TENDERS FOR CAST IRON WATER PIPES.

The Corporation of Durban, Natal, is prepared to receive TENDERS for the SUPPLY and DELIVERY, Stores, Durban, of about 350 TONS of 12in., 9in., 8in., 6in., and 4in. CAST IRON PIPES, to be approved by the Representative Engineers, Messrs. W. H. Radford and Son, Albion Chambers, Nottingham.

Specifications, by the Water Engineer, Mr. Walter M. Campbell, M. Inst. C.E., can be obtained from, and sealed and endorsed Tenders must be delivered to, the undersigned on or before 13th February, 1922.

The lowest or any Tender will not necessarily be accepted.

By Order,
WEBSTER, STEEL and CO.,
5, East India-avenue,
Leadenhall-street, London, E.C. 3,
7328 Agents to the Corporation.

Corporation of Durban, Natal.
TENDERS FOR STEEL PIPES.

The Corporation of Durban, Natal, is prepared to receive TENDERS for the SUPPLY and DELIVERY, Stores, Durban, of about 2700 FEET, 20 to 25ft. lengths, STEEL PIPES, and No. 12 STEEL COLLARS, to be approved by the Representative Engineers, Messrs. W. H. Radford and Son, Albion Chambers, Nottingham.

Specifications, by the Water Engineer, Mr. Walter M. Campbell, M. Inst. C.E., can be obtained from, and sealed and endorsed Tenders must be delivered to, the undersigned on or before 13th February, 1922.

The lowest or any Tender will not necessarily be accepted.

By Order,
WEBSTER, STEEL and CO.,
5, East India-avenue,
Leadenhall-street, London, E.C. 3,
7329 Agents to the Corporation.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

January Engineering Notes.

A Large Omnibus Overhauling Works.

1600 B.H.P. Nobel-Diesel Marine Engine.—No. II.

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Three-Cylinder Locomotive for Spain (With a Two-Page Drawing).

Observations on a Producer Gas Power Plant.

American and European Engineers.

British Railway Speeds in 1921.

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PUBLIC NOTICES

Corporation of Calcutta.
NOTICE TO CONTRACTORS.
TAR-SPRAYING MACHINE.

TENDERS are INVITED for the SUPPLY and DELIVERY complete in working order at Corporation Workshops, Entally, Calcutta, of ONE TAR-SPRAYING MACHINE. The machine shall be arranged so as to be drawn by a steam road roller. The tank is to have a capacity of about 600 gallons. Means are to be provided for applying the tar under pressure and for heating the tar. Tenderers shall submit a detailed description and specification with illustration or drawings of the machine they offer and shall state the time required for delivery.

Tenderers shall submit Tenders on their own forms in duplicate enclosed in sealed covers and superscribed "Tender for Tar-spraying Machine." Tenders should be addressed to the Deputy Chairman, Corporation of Calcutta, Central Municipal Office, 5, Corporation-street, Calcutta, and should reach him on or before Monday, the 20th March, 1922, when they will be opened in the presence of such tenderers as may be present. Tenders must remain open for acceptance for a period of at least eight weeks from the date of opening. For further particulars, if required, apply to the Chief Engineer to the Corporation.

J. R. COATS, B.Sc., M.Inst.C.E.,
Chief Engineer to the Corporation.

Central Municipal Office,
The 7th January, 1922. 7301

County Borough of Brighton.
TO CONTRACTORS AND OTHERS.

Notice is hereby given that the Council of the said County Borough will receive TENDERS from such persons as may be willing to enter into a contract for CONSTRUCTING and COMPLETING a WINDING SHAFT and other works in connection with the Mile Oak Pumping Station, Portslade, Sussex.

The specification and form of Tender may be obtained on application at my office at the Town Hall, Brighton.

Sealed Tenders, addressed to me and endorsed "Tender for Constructing Winding Shaft, &c.," must be left at my office at the Town Hall before Ten o'clock in the forenoon on Tuesday, the 14th day of February, 1922.

The Council do not bind themselves to accept the lowest or any Tender.

Persons tendering must do so at their own expense.

HUGO TALBOT,
Town Clerk.

Town Hall, Brighton,
29th January, 1922. 7312

TO FIRMS WANTING WORK.

Quotations are Required, Either separately or collectively, for the following UNITES, which comprise new patterns of the Harley Heat Retaining System:—

(A) 225 3in. bore, Hand-operated, Single-acting BRASS AIR PUMPS; (B) 75 3in. bore, Double-acting DITTO, but with different lines and lay-out; (C) 200 Double-walled BRASS VACUUM TANKS, circular section, in two sizes, 7¼in. dia. by 49¼in. and 7¼in. by 61½in., of thin gauge brass tube or rolled sheet; (D) 300 SETS Small CONTROL VALVES and Allied Mechanism, to three designs, embodying similar main details, in brass, &c.

The above are repetition products subject to repeat orders; therefore applications from serious people are required.

Drawings, which show all details and may not be departed from, are obtainable from the undersigned upon payment of the following fees, which are not returnable under any circumstances:—For (A) and (B) separately, £1 1s. each; together, £1 10s.; (C), 15s.; (D), £1 1s.

The advertiser does not bind himself to accept the lowest or any Quotation.

Applications to H. GEORGE HARLEY, General and Consulting Engineer and Proprietor of Harley Patents, Grand-avenue, Camberley. 7344

PUBLIC NOTICES

Romford Rural District Council.
RIVERSIDE SEWERAGE.
OUTFALL SEWER.—CONTRACT NO. 2.

The Council are prepared to receive TENDERS for the CONSTRUCTION of about 4280 FEET of 36in. Diameter CONCRETE SEWER and other works in the parishes of Dagenham and Hornchurch.

Drawings, specification and quantities may be inspected at the office of Mr. William Fairley, M. Inst. C.E., Parliament Mansions, S.W., or at the Council's Offices, 16a, South-street, Romford, on application to Mr. W. J. Grant, Surveyor.

A limited number only of the quantities and form of Tender are available for issue to approved firms.

Tenders to be lodged with the undersigned on or before Monday, 20th February, 1922.

The Council do not bind themselves to accept the lowest or any Tender.

T. W. A. GREENHALGH,
Clerk to the Council.

16a, South-street, Romford,
31st January, 1922. 7323

Tenders Invited for Purchase of Priestman GRAB DREDGER, Delivered new in May last.

Particulars, CLERK, pro tem., River Stour (Essex and Suffolk) Drainage Board, Sudbury, Suffolk. P4820

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely:—

No.		Specification Fee.
1.	INDIA-RUBBER HOSE PIPES, SHEETS, &c.	5s.
2.	CANVAS HOSE PIPES	£1
3.	SPARK ARRESTERS, SIEVES, &c.	7s. 6d.
4.	LAMP GLASSES, &c.	2s. 6d.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for India-rubber Hose Pipes, Sheets, &c.," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 14th February, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2.
London, 1st February, 1922. 7310

CEMENT GUN AND PORTABLE AIR COMPRESSOR.

The Swansea Harbour Trustees invite TENDERS for the HIRE for about two years of a CEMENT GUN and PORTABLE AIR COMPRESSOR, together with all necessary hose and fittings complete.

Further particulars may be obtained on application to the Trustees' Engineer at the Harbour Offices.

Tenders, sealed and marked "Tender for Hire of Cement Gun and Compressor," to be delivered to the undersigned on or before Friday the 17th February, 1922.

The Trustees do not bind themselves to accept the lowest or any Tender.

TALFOURD STRICK,
Clerk to the Trustees.

Harbour Offices, Swansea,
30th January, 1922. 7308

PUBLIC NOTICES

TO SHIP AND BARGE BUILDERS.

Tenders are Invited for the CONSTRUCTION and DELIVERY complete afloat to London of SIX or more OPEN RIVER SWIM-ENDED DUMB BARGES, to be built of S.M. mild steel to the following dimensions:—

Lengths: O.A., 96ft.; hold, 49ft.; fore deck, 19ft. 6in.; after deck, 17ft. 6in.

Breadth on top at fore bulkhead, 22ft.; at after bulkhead, 22ft. 6in.; at bottom at fore bulkhead, 16ft.; at after bulkhead, 17ft. 4in.

Depth from top of gunwale amidships, 7ft. 6in.; sheer forward, 2ft. 8in.; aft, 2ft.

Frames in hold, bulb angles, 5in. by 2½in. by 3-8in., spaced 21in. apart.

Frames forward and abaft bulkheads, 5in. by 2½in. by 3-8in., spaced 15in. apart.

Floors in hold "Z" bars, 6in. by 3½in. by 3-8in.

Keelsons, two channels, each 8in. by 3in. by 19.3 lb. In two lengths extending 4ft. up each swim.

Chime angle bars, 3in. by 3in. by 3-8in. Beams to alternate frames, 3½in. by 2½in. by 3-8in., with knee plates.

Gunwale, 24in. wide by 5-16in. chequered plates. Fore and aft decks chequered 5-16in.

Huddis plate, 4in. Bulkheads (2), 6/20in. with 3½in. by 2½in. by 3-8in. stiffeners 30in. apart.

Main beam, 6in. by 4in. "T" bulb cambered 6in.

Gunwale angle round backed, 3½in. by 2½in. by 4in.

Coamings, 12in. by 3-8in. flanged to deck.

Bowboards, 8in. by 3-8in. bulb angle. Sternpost plate, 4in. Budget, 5/16in. between double angle bar frame, 2½in. by 2½in. by 5/16in. and stayed to bottom at bulkhead by a plate 4in. thick, 18in. wide.

Plating sides and bottom, 3-8in. Sheerstrake, 4in.

Rudder, tiller, windlass roll and bitts, of oak. Turee oak stems on fore swim, 6in. by 3½in./3in. between angle bars, 2½in. by 2½in. by 6/20in.

After cabin plainly lined and fitted with stove.

Riveting to Lloyd's rules.

Ceiling, 3in. pitch pine, long lengths.

Four cast iron dollies opening through top, 8in. in diameter.

The lowest or any Tender not necessarily accepted by

TOUGH AND HENDERSON,
Tug and Barge Owners,
68, UPPER GROUND ST., BLACKFRIARS,
LONDON, S.E. 1. P4336

Shanghai Municipal Council.
PUBLIC WORKS DEPARTMENT.
APPOINTMENT OF TWO ASSISTANT ENGINEERS.

TWO thoroughly qualified ASSISTANT ENGINEERS are REQUIRED in the Public Works Department.

(a) Candidates must be unmarried, not more than 30 years of age and should hold the Testamur of the Institution of Municipal and County Engineers or have passed the examination for Associate Membership of the Institution of Civil Engineers; or

(b) Hold a degree in engineering from a university in Great Britain.

Salary, Taels 350 per mensem, without allowances, under a three years' agreement, with first-class passage halfway on voyage and free medical attendance. There is an excellent superannuation scheme.

(c) The value of the tael at the present rate of exchange is about 3s. 6d., but it is liable to fluctuation. Taels 350 per mensem at exchange 3s. 4d. is equivalent to about £700 per annum, but the salary is payable in taels without reference to rate of exchange.

Particulars of the appointment may be obtained from

Messrs. JOHN POOK and CO.,
Agents for the Shanghai Municipal Council,
66, Fenchurch-street, London, E.C. 3.
February, 1922. 7322

HOLDERNESS DRAINAGE.

The Trustees Invite Applications for the POST of ENGINEER and SURVEYOR of the Holderness Drainage. The duties entail the supervision and upkeep of extensive Arterial Agricultural Drains with two important Outfall Sluices into Tidal Rivers. Salary £340 per annum. Applications, stating age, qualifications and experience, with copies of not more than three recent testimonials, to be sent to me not later than 23rd February, 1922.

THO. B. TODD,
Clerk to the Holderness Drainage Trustees.
24, Lairgate, Beverley. 7317

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
SEA WAVE MOTORS.

The Proprietor of British Patent No. 24,918 of 1913 is PREPARED to SELL the PATENT or to LICENSE British manufacturers to work under it. It relates to apparatus for utilising the movement of sea waves to pump water for operating hydraulic motors.

Address, B., W. & T.,
111/112 Hatton-garden,
7294 London, E.C. 1.

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SITUATIONS OPEN

WANTED by Old-established Firm of Crane Makers, in North of England, an energetic YOUNG MAN, with some experience of Crane Work, to Take Over Sales Department and Travel for Orders. Progressive position for right man. Applicants must state age, experience, and salary required.—Address, 7352, The Engineer Office. 7352 A

WANTED, INSPECTOR and TURNCOCK for Water undertaking (town and country district). Only experienced man used to High-pressure Mains need apply. Must be married and about 35 years of age. State particulars of experience, salary required, and references.—Address, 7317, The Engineer Office. 7317 A

WANTED for Small Engineering and Foundry Works outside of London, a Young ENGINEER, 28-33 years, to Assist Works Manager. One with a small shop experience and gas experience preferred. Able to control men; capable of estimating foundry work from drawings. State experience, age, and wage required.—Address, P4832, The Engineer Office. P4832 A

WANTED, a Young MAN for the Publicity Dept. of an Engineering Establishment.—Apply JAMES CARMICHAEL and CO., Ltd., Ward Foundry, Dundee. P4818 A

A FIRM of IRON and STEEL MANUFACTURERS in South Wales REQUIRE a practical MAN (30 to 40 years of age) as CHIEF WORKS ENGINEER. Must have had previous experience in a similar capacity and be fully conversant with the running of Blast-furnaces, Steel Works, Rolling Mills, and subsidiary plants. State age, experience, and salary required in strict confidence.—Address, 7326, The Engineer Office. 7326 A

A HIGHLY QUALIFIED and INVENTIVE ENGINEER WANTED as Director for the British Cutlery Research Association.—Apply, stating experience and salary required, F.O. Box 49, Sheffield. P4833 A

ASSISTANT CIVIL ENGINEER REQUIRED for Public Works Contract in Far East. Must be fully qualified setting out work; previous experience contractors' staff desirable; eighteen months' engagement. Free passage, free bachelor's quarters. Salary according to experience.—Write, with particulars, to A. C. E., c/o Messrs. A. W. Brown, 39, Tothill-street, S.W. 1. 7334 A

CHIEF DRAUGHTSMAN WANTED; Must be a first-class structural steel designer with experience organising and managing a large drawing-office making shop drawings for steel bridges, buildings, factories and supports for machinery according to latest efficiency methods of system, speed and economy, of draughting, manufacture and erection. Good position with old-established engineering manufacturing company in London district for such a man, able to shoulder responsibility, manage efficiently staff of draughtsmen, and turn work out competitively.—Address, with full particulars, 7349, The Engineer Office. 7349 A

CIVIL ENGINEERING and STRUCTURAL STEEL WORK DRAUGHTSMAN WANTED IMMEDIATELY on North-East Coast. Must have thorough experience in the Design of Steel and Ferro-concrete Building Structures, Overhead Bunkers and Heavy Foundation Work. Only men with initiative and capabilities for taking charge of section of drawing-office and correspondence dealing with this work need apply. Permanency and good prospects of advancement to suitable man.—Address, stating experience, age, and salary required, 7290, The Engineer Office. 7290 A

ENGINEER.—A General Engineering FIRM have a VACANCY for an experienced DESIGNING ENGINEER accustomed to Gear Work for Steam Turbines. Only those who have actually been in charge of design and who possess good technical experience need apply. State full particulars of previous experience, age, and salary required.—Address, 7340, The Engineer Office. 7340 A

FOUNDRY AND ENGINEERING WORKS.—MANAGER WANTED, age 30-35. Thorough knowledge up-to-date pattern and moulding methods; some commercial experience. Salary £400 and bonus.—Address, P4815, The Engineer Office. P4815 A

HEATING ENGINEER REQUIRED by Leading London Firm for complete design of Hot Water, Steam and Vacuum Heating Installations for Public Buildings, &c. Knowledge of Plenum work also desirable. Give full details of experience and state age and salary expected.—Address, 7315, The Engineer Office. 7315 A

MALLEABLE IRONFOUNDERS (Staffordshire) REQUIRE COMMERCIAL MANAGER with expert knowledge and good connection.—Address, P4756, The Engineer Office. P4756 A

REDBOURN HILL IRON and COAL CO., Ltd., REQUIRE a thoroughly practical MAN as CHIEF WORKS ENGINEER. He must be capable of Taking Charge of all Plant of a large Blast-furnace and Steel Works, including Coke Ovens and Ore Mines, &c. Must be executive and a conscientious worker.—Applications, which will be treated in strictest confidence, should be marked confidential and state age, experience, where employed and salary required, to the SECRETARY of the Company, Frodingham, Lincs. 7272 A

REINFORCED CONCRETE.—WANTED for Reinforced Concrete Specialists and Contractors in India, ASSISTANT ENGINEER; must have sound technical training with experience in design and construction. Write, stating full particulars and qualifications, age, &c. Liberal terms for good man.—Z. L., 921, c/o Deacon's, Leadenhall-street, London. 7270 A

REQUIRED for Small General Engineering Works in the South of England, ASSISTANT FOREMAN of ERECTING SHOP. All-round experience of Machine, Fitting and Boiler Work essential. Must be capable and pushing and able to get work through. State experience and salary required.—Address, 7316, The Engineer Office. 7316 A

SUPERINTENDENT.—REQUIRED by a Large Motor Manufacturing Firm, a GENERAL MACHINE SHOP SUPERINTENDENT. Must be thoroughly familiar with up-to-date methods of production and shop practice, and also be used to producing work to fine limits. Must also have held similar positions previously. Address, stating age, experience, and salary required, P4825, The Engineer Office. P4825 A

WORKS MANAGEMENT.—WANTED, TWO Qualified ASSISTANTS, with first-class practical and theoretical experience; (a) one for the Manufacture of Generators, Turbo-alternators, Motors, &c.; and (b) one for Steam Turbines, Condensers, Pumps, &c. Applications are invited from men with a thorough knowledge of the manufacture of the apparatus mentioned, and only those who have exercised executive control in an engineering works need apply. Applicants must be of good personality and familiar with the most up-to-date methods of manufacture. Applications (which will be treated in confidence) should give full details of experience, positions held, and qualifications for the vacancies, and should include age of the applicant and salary required. The positions offer excellent prospects to suitable applicants.—Address, 7281, The Engineer Office 7281 A

WANTED, Capable DRAUGHTSMAN, Accustomed to Pumps for Marine and General Service. Good prospects for suitable man.—Send full particulars which will be treated in confidence, to PHILIP S. DOHERTY (Engineers), Ltd., 25, Victoria-street, S.W. 1. 7342 A

DRAUGHTSMAN, AERIAL ROPEWAYS.—First-class MAN WANTED, accustomed to Preparing Schemes and Tenders.—Apply, stating age, experience, wages required, when free, to Chief Draughtsman, JOHN M. HENDERSON and CO., Aberdeen. 7283 A

DRAUGHTSMAN WANTED for Aircraft Works in Preston, Lancs.—Address, stating age, experience, and salary required, P4851, The Engineer Office. P4851 A

SITUATIONS WANTED

ADVERTISER (35) SEEKS POSITION; Experienced 4 switches, crossings, lay-outs, steam, petrol locos., also pumps; 7 years' charge of D.O., 2½ charge of small works; good references.—Address, P4798, The Engineer Office. P4798 B

BRITISH ENGINEER SEEKS POST Abroad, Temporary or permanent, or home; 21 years' experience design and erection power plants, elec. cranes, ordnance, pipe lines, oil fuel installs, mining and gen. engineering, correspondence, quantities, supervision works and office. Fluent French, elem. German.—Address, P4849, The Engineer Office. P4849 B

BUYING ENGINEER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M. 613, c/o Deacon's, Leadenhall-street, E.C. 3. 7251 B

CHEMICAL ENGINEER, Who Thoroughly Appreciates the difference between laboratory and works practice, DESIRES POST to a go-ahead firm where his services would be of value.—Address, P4823, The Engineer Office. P4823 B

CIVIL ENGINEER (33), Graduate Arts Engineering Inst., 1st class degree, honours, 10 years' experience public works, India, survey, design, construction and maintenance canal and drainage works, roads, buildings, shortly retiring Govt. service, DESIRES to hear of suitable APPOINTMENT.—Address, P4767, The Engineer Office. P4767 B

CIVIL ENGINEER, with Experience in Different Colonies, DESIRES APPOINTMENT, railways, water, prospecting, reporting, surveys of all kinds, town-planning. Excellent references.—Address, P4855, The Engineer Office. P4855 B

COMMERCIAL MANAGER (42) is DESIROUS of similar POSITION. Thoroughly experienced in the administration and detail of all departments. Appointments held:—Chief of costing and estimating, chief accountant, (commercial) manager, assistant general manager. Accustomed to full control in absence of directors. Highest credentials.—Address, P4856, The Engineer Office. P4856 B

CONSTRUCTIONAL STEEL WORK DRAUGHTSMAN, 12 years' experience, designing and detailing all classes of heavy and light structures, REQUIRES RE-ENGAGEMENT.—Address, P4826, The Engineer Office. P4826 B

ELECTRICAL ENGINEERING.—Articled PUPIL just out of his time, age 20½, REQUIRES POSITION as Improver; good draughtsman, excellent references.—JOHN SKINNER, Silverdale, Richmond-road, Taunton. P4834 B

ENGINEER, A.M.I. Mech. Eng., DESIRES Progressive ADMINISTRATIVE POSITION in works located Midlands or South. At present representing steel, malleable and iron founders. Sound knowledge of general engineering and foundry practice. Good connection with engineering firms in England and Scotland.—Address, P4850, The Engineer Office. P4850 B

ENGINEER, A.M.I. Mech. E., REQUIRES APPOINTMENT, home or abroad; 15 years' practical and theoretical experience of large collieries, design, lay-out, sinking and equipment, &c.—Address, P4765, The Engineer Office. P4765 B

ENGINEER, Mechanical, Ex-Engineer Officer (Major), A.M.I.C.E., &c., WISHES EMPLOYMENT, technical or commercial. Experienced engineer and surveyor, disciplinarian; could control undertaking or represent one or two substantial firms; good connection South Wales.—Address, P4785, The Engineer Office. P4785 B

ENGINEER, Mechanical (38), 10 Years D.O., 5 Years erecting, testing, 5 years consulting engineers, steam, oil, marine machinery, DESIRES POST.—Address, P4860, The Engineer Office. P4860 B

ENGINEER SEEKS SHORE APPOINTMENT. First-class B.O.T. certificate; age 39; time served in London. Excellent reference. Disengaged by February 17th.—Address, P4837, The Engineer Office. P4837 B

ENGINEER (23), 4½ Years Pupil, Vickers Ltd., 2½ drawing-office experience, SEEKS POSITION at home or abroad.—Address, P4829, The Engineer Office. P4829 B

GLASS WORKS ENGINEER.—Englishman, Mem. Iron and Steel Inst., A.M.I.E.E., at present engineer and manager bottle works in France, is at liberty for new ENGAGEMENT, England or abroad, due to closing down of factory. Thorough knowledge of machines and furnaces and can handle men. Excellent testimonials.—Address, P4865, The Engineer Office. P4865 B

MECHANICAL and ELECTRICAL ENGINEER (36) DESIRES APPOINTMENT as General or Works Manager where brains, energy and initiative are of value; exceptional experience of mass production, tool design, estimating, costs, &c., and control of large staffs.—Box 435, Halston, High-road, Goodmayes. P4724 B

MECHANICAL ENGINEER, Late Manager of Small works, SEEKS POST where 20 years' general experience, organising ability, tact, and initiative will be useful.—SNOAD, 38, York-road, Hitchin. P4844 B

SITUATION.—MECH. ENGINEER (32), Accustomed maintenance and charge of plant, native labour, speaks Malay, REQUIRES SIT., home or abroad.—Address, P4819, The Engineer Office. P4819 B

SITUATION WANTED by Ex Chief Stoker, R.N., as DRIVER of STEAMBOAT or one with Kromhout oil engines; can handle most repairs or can work and take charge of boilers and necessary machinery, look after dynamo engines, &c.; would be willing to go abroad or anywhere on a job where useful man is required; can be trusted.—BROWN, 46, Kimbolton-road, Cosnor, Portsmouth. P4835 B

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For continuation of Small Advertisements see page iii

JANUARY.

The Electrification of Main Line Railways.

DURING the month considerable public attention was attracted to the question of electrifying our railways, partly as a result of the proposals now being discussed between certain companies and the Ministry of Transport regarding the electrification of some of the London suburban lines, but more especially as a result of the important joint meeting of the Midland branches of the Civil, Mechanical and Electrical Engineers, held at Birmingham on the 20th. That meeting was organised with the object of discussing the electrification of main line as distinct from suburban railways, and was attended by many well-known railway engineers and others intimately interested in the question. From the views expressed in the course of the discussion it is obvious that the opinion of many people, to whose views our best attention should be given, is by no means definitely settled in favour of main line electrification. It was generally agreed that suburban railway electrification was in nearly every case justifiable; but it was admitted that the density of traffic was a decisive factor, and that at present we did not know at what value of the density the advantages of electrification began. One or two speakers urged the view that on this point it would be wrong to take the prevailing density with steam services as the basis of calculation for the electrified services, for, they argued, in nearly every instance of which we had experience, electrification brought increased traffic. One speaker, carrying this argument farther, urged in effect that we should entirely change our outlook when considering electrification; that we should not simply regard it as an alternative method of hauling trains, but as an improved means of operating railways. The present-day long train was, he said, an inheritance of the steam locomotive and was not best suited for electrical operation. He desired to see railway engineers considering electrification free from steam traditions, and suggested that if they did so they would arrive at a high-speed frequent service of short trains as the scheme most likely to take advantage of the possibilities present in railway electrification. More than one speaker deplored the Railway Electrification Advisory Committee's choice of 1500-volt direct current as the standard system for British railways, a distinct preference being expressed for single-phase current of high voltage. In general it was agreed that if heavier trains were to be handled it would be impossible to continue the use of steam locomotives; but on the question of first cost and maintenance expenses opinion was far from being unanimous that the advantage lay with electrification.

The Motor Ships Pinzon and Ardito.

ALTHOUGH we have now in service excellent examples of both four-cycle and two-cycle engine construction, there seems to be no lack of appreciative interest on the part of engineers and shipbuilders in their endeavour to discover the type of Diesel engine best suited to meet the demands of the problem of marine propulsion as regards flexibility and reliability. A further factor prominent in discussion is the reduction of the present difference in cost between internal combustion engine and steam engine equipment. The extended series of trials of the motor ship Pinzon which were carried out on the Clyde by William Beardmore and Co., Limited, about the middle of the month, marked an occasion of unusual interest, as the vessel's engine is the first that has been constructed at Dalmuir of the Tosi pattern, embodying new features introduced by Messrs. Beardmore. The trials over the measured mile at Skelmorlie showed the vessel capable of a speed of over 12 knots, and successful manœuvring and reversing trials were also performed. In our issue of November 11th we described some of the main features of this improved type of four-cycle engine and its performance. Facts and figures are not wanting with regard to the sea performance of a similar engine, since twin engines of almost exactly the same design and power were built by Messrs. Franco-Tosi, of Legnano, Milan, for the motor ship Ardito. The Ardito was launched from the firm's Taranto shipyard about the middle of last year, and she has since traded regularly between Cardiff and Genoa. During the six months or so that she has been running the machinery has, so it is reported, given excellent results, the fuel injection valves, the combined inlet and exhaust valves, and director valve gear having proved satisfactory.

The Threatened Water Famine.

THAT the Ministry of Health is fully alive to the seriousness of the water supply question as the result of the drought, was evidenced by the appointment during the month of an influential committee to consider the best methods of treating water, possibly from polluted sources, so that it may be made fit for domestic use. The chairman of the Committee is Mr. L. G. Gibbon, Assistant Secretary of the Ministry, and the other members of the body are Sir Alexander Houston, Dr. W. A. Bullock, Dr. Hill, Mr. Raymond Ross, Mr. T. W. Davies, Mr. R. J. Simpson, Mr. E. A. Standford Fawcett, and Dr. Wheaton. Sir Alexander Houston's work as Director of Water Examination to the Metropolitan Water Board is well known. His services should be of the greatest value in the investigation. Drs. Bullock and Hill are both of them Medical Officers of Health of wide experience. Mr. Raymond Ross is the Public Analyst for Burnley, and Mr. Davies a Waterworks Engineer, who is representing the Waterworks Association. Mr. Standford Fawcett is, of course, Chief Engineer to the Ministry of Health, to which body Dr. Wheaton and Mr. Simpson also belong. The distribution of rainfall throughout the kingdom during the last twelve or fifteen months has been most irregular. While some few districts have had an ample volume, others have experienced a very decided shortage, and at the present time there are places which are entirely without any water at all, while in others the most rigid economy has to be practised, with, in some instances, curtailment of the hours of supply. It is feared that the condition of affairs may, unless very heavy rainfall is experienced, be aggravated rather than improved during the coming months. A good deal was learnt during the war as to the possibility of rendering polluted water fit for human consumption, and it is to be presumed that the present Committee, among its other functions, will see to the dissemination of the knowledge then gained. It is satisfactory in any case to know that the Ministry of Health is interesting itself in the vital question of ensuring pure water supplies, and it has certainly been happy in its choice of the members of the Committee which it has appointed.

The Corrugation of Rails.

AN item of interest both to tramway and railway engineers was the final report published during the month of the Rail Corrugation Sub-committee of the Municipal Tramways Association. After several years of observation and investigation in the London area the Committee came to the conclusion that the corrugation of tramway rails—a phenomenon that also affects railway rails—is caused, not by vibration in the rails themselves or in their foundations, but by the fact that where it does occur the wheel loads passing over the rails are such as to produce a surface stress in the material in excess of its elastic limit. As a result plastic flow takes place, and in time the rail surface becomes waved after the manner in which, as is well known, a steam roller waves the surface of a new road in process of being laid. The establishment of this fact will, no doubt, be taken advantage of in the design of new vehicles, but it would appear that much additional information is yet required before our knowledge of the subject can be regarded as satisfactorily complete, particularly with reference to the evaluation of the actual stress on the rail produced by a wheel of given diameter with a given load, and as to by what extent the elastic limit may be locally exceeded without causing corrugations to appear. The London County Council tramway cars are already exceptionally heavy vehicles. It is therefore somewhat surprising to note that, in spite of the Corrugation Committee's finding, the Council is about to put into service a new and apparently still heavier type of car, namely, one having the same seating capacity as at present—that is, for seventy-eight passengers—but equipped with 60 horse-power motors as compared with those of 44 horse-power at present in use. The added weight and the increased speed will certainly not tend to diminish the troubles arising from rail corrugations.

The Co-ordination of Electricity Undertakings.

THE inquiry into what is known as the South-East Lancashire electricity scheme, which was held in Manchester during last month by the Electricity Commissioners, created a good deal of interest. It extended over three days and was attended by power station engineers from all the neighbouring towns. The scheme has for its object the co-ordination of all the leading sources of electrical energy in the great industrial area lying between Wigan, Rochdale, Glossop and Knutsford by the formation of an advisory board, which will direct expansion, investigate the conditions under which the plants already in existence are operating, and the supply and transmission resources. Further than this, acting under the advice of a technical committee, the board will suggest to the various undertakings within its scope under what conditions they shall continue to operate. The alternative to this voluntary body is an official joint electrical authority which would have certain definite powers. The scheme provides for the closing down of some of the existing stations within the area, the building of others and the laying of new intercommunication cables. Some of the objects of the board have, it may be mentioned, already been achieved, for some 80 per cent. of the stations involved are already linked up one with another. The local authorities which approved the scheme of an advisory board represented 93 per cent. of the rateable value of the whole area. The joint board of Stalybridge, Mossley, Hyde and Dukinfield with Romiley and Bredbury dissented. Salford and Stretford, while supporting the scheme, favoured the establishment in the future of a joint electricity authority. Ultimately Stalybridge decided to "come in" on special terms. The chief difficulty which presents itself to the scheme is in connection with the right of appealing to the Electricity Commissioners in case of dispute and the power of enforcing decisions. The result of the inquiry will be awaited with interest.

The Scottish Railways Wages Award.

THE National Wages Board was engaged from the 11th to the 20th of the month considering the claims of the Scottish railway companies for the withdrawal of the extra pay granted by the then Board in June, 1920, the discontinuance of the payment of overtime for the hours worked between 10 p.m. and 6 a.m., the raising of the age when youths shall be regarded as adults, and a modification of the eight hours' day. The railway companies' case was very ably presented by Mr. Donald A. Matheson, the general manager of the Caledonian Railway. It was based mainly on the fact that, the railwaymen's pay in Scotland being lower than in England and the hours being longer, the introduction of a universal eight hours' day as from February 1st, 1920, and the introduction of uniform wages in March, 1920, increased the wages bill of the Scottish companies proportionately more than they did that of the English companies. Moreover, rates and fares in Scotland being lower than in England and the increases made therein having been on a percentage basis, any increase in receipts due to the higher rates and fares was less in proportion than was that of the English companies. The Scottish companies were thus doubly penalised. The Board gave its award on the 25th. Whilst it was neither a victory for the companies nor for the men, it cannot be described, as has been suggested, as a compromise. The judgment of the Board would appear to meet the merits of the case. The extra pay given in June, 1920, is no longer warranted; but apparently because the men have just lost five shillings per week under the sliding scale, it would be hard to dock the further sum at one fell swoop, so it is to come off in the same way as those under the sliding scale—one shilling for every five points' change in the cost of living. Extra payment for work done between 10 p.m. and 6 a.m. is to be continued. Youths are not to receive men's pay until they reach twenty years of age—the companies asked that the age should be twenty-one. With that part of the award which deals with the eight hours' day the companies have, we think, little to complain. All men may be rostered up to nine hours a day, provided that the extra hour be paid for at overtime rates; men holding occupations as typified by the examples presented to the Board may have their eight hours spread over a period up to ten hours long, and, where circumstances render it essential, up to a maximum of twelve hours. It is significant that the award was signed by four of the six representatives of the companies, the two dissentients being Scottish general managers. Of greater significance is the concluding paragraph of the award:—"The Board desire to place on record that their decision in respect to wages and the conditions of service must not be regarded as establishing a precedent or as fettering the judgment of the Board in dealing with any cases submitted to them in future."

A New French Gun.

DURING the month much interest was evinced in a new gun which is the invention of a French officer, Lieutenant Delamare-Mazo. Experiments with the weapon have been in progress for some time, principally in Belgium, and next week some official trials of it are to be carried out at Liége under the auspices of the Belgian Government, which holds the Belgian licence for the patent. Details of the invention, which, it is claimed, can be applied equally well to field and machine guns, as well as to rifles, have not at present been divulged; but it is claimed that as a result of its application the recoil is eliminated and the speed of the projectile practically

doubled. In past trials with a French "soixante quinze" it is stated that a muzzle velocity of 850 m., say, 2789ft.—per second was obtained, the ordinary velocity being about 1740ft. per second. It is hoped, as the result of improvements since made, that a muzzle velocity of something approaching 3300ft. per second will be reached. The inventor asserts that with the recoil done away with it will be possible to build guns as powerful as those at present in existence at only a third of their weight.

Railway Signals.

THE equipment by the Liverpool Overhead Railway Company of the whole of its line, when it was re-signalled last summer, with colour light signals instead of semaphores, whereby the indications by day as by night are given by coloured lights, led to the appointment by the Ministry of Transport of a very practical Departmental Committee to consider the potentialities of light signals. The report of that Committee was issued on the 11th of the month, and showed that the members were all favourably impressed with the possibilities of coloured light signals; they went as far as to say that they were of the opinion that that type of signal could be arranged to meet, as far as could be seen, all conditions now covered by the existing semaphore type. The installation in Liverpool had been inspected, and it was found that in brilliant sunshine, when the sun was immediately behind and also in front of the signals, the lights were distinctly visible 1000 yards away. On the question of cost it was said that where there was a density of signals the cost of installation and maintenance was less than in sparsely signalled areas the advantages of the light signals could be obtained with little difference of cost as compared with mechanical semaphores. An admirable feature of the report is that it recognises that light signals have not yet reached finality of design, and so the recommendations leave the way open for future developments and there are no hampering restrictions. It is of interest to note that in the report by Colonel Pringle, issued subsequently, on the fatal collision of November 26th at Birmingham (New-street) it is recommended that to improve the running view of certain signals in the station colour light signals be provided over the running roads in question. With semaphore signals this would be expensive, but light signals require less costly support than semaphores and can be fixed where the latter cannot.

The Chiswick Overhauling Depot.

THE opening of the new omnibus overhauling depôt of the London General Omnibus Company at Chiswick, which took place on the last day of January, was noteworthy for several reasons. To begin with, it represents a pioneer effort in employing mass production methods in the overhauling of worn machinery. All the work progresses with the same precision as in a most highly organised factory, and every part of the chassis follows a pre-arranged programme. Then, again, the magnitude of the operations is rather striking for this class of work. The company possesses 3000 motor omnibuses, and every one of them has to be completely pulled to pieces, re-conditioned and re-assembled once a year. Before the new works were started the overhauling of a vehicle occupied sixteen days. It is now done in four, so that 36,000 omnibus-days are saved under the new *régime*. It is obvious that the establishment in which the overhauling is effected must be of considerable size, and the works are conspicuous on account of the main building. It covers an area of nearly 300,000 square feet, and in the engineering department is open from side to side throughout its width of over 350ft. An example of the value of careful prevision was given during the construction of the building, when a very heavy gale sprang up. The foundations had been laid out so carefully that all the holding down bolts were cast into the concrete footings and the stanchions for the roof were dropped in place without any shim plates or grouting. The roof had been completed, but the side walls were not built, when the gale just mentioned sprang up. It was so violent that a 9in. brick lavatory wall within the building was blown down, but the main structure suffered no harm. Had the usual procedure of going on with the roofing while the foundation bolts were being grouted in been adhered to, it is almost certain that the whole structure would have been wrecked. The same careful preparations were made in connection with the laying down of the machinery, and the result of all this planning was that the building was in a habitable condition very few months after construction was started, and it was possible to commence operations in the various departments as they were completed.

Tables of British Railway Speeds in 1921.

BELOW are our annual statistics of British railway speeds. As is well known, the railway companies celebrated the change over from Government control by many important accelerations and restoration of pre-war facilities, these improvements being found in their summer time-tables, which came into operation on July 11th; though, but for the coal dispute, some of them would have been instituted earlier in the year. In the case of certain companies, notably the Great Western, the Midland, and the Great Central, further improvements have been carried out in the winter time-tables, dated October 3rd.

Table A furnishes comprehensive comparisons in regard to arterial communications, with special reference to the progress that has been made since the Armistice. It should be explained that the distances given are those for the fastest journeys at the present day. Before the war the distances were occasionally slightly shorter by reason of more direct routes being taken, while during the war they were occasionally longer, as, owing to the restricted train service, it was necessary to make the most of a train. However, in calculating the average speed of each journey at each period the distance actually covered has been allowed for.

TABLE A.—*Fastest Journeys between London and Principal Towns in* 1921, *at Date of the Armistice, and in* 1914 *pre-war.*

Town.	Company or route.	Distance.	Fastest journey in 1921.		Fastest journey, November, 1918.		Fastest journey, July, 1914.	
			Time spent.	Average speed.	Time spent.	Average speed.	Time spent.	Average speed.
		Miles.	h. m.	m.p.h.	h. m.	m.p.h.	h. m.	m.p.h.
Aberdeen	East Coast	523½	12 15	42.7	13 30	38.7	11 7	47.0
Aberdeen	West Coast	539½	12 20	43.7	—	—	11 15	48.0
Bath (slip)	G.W.	106½	1 45	61.0	1 58	54.4	1 48	59.4
Birmingham	G.W.	110½	2 0	55.2	2 30	44.1	2 0	55.2
Birmingham	L. and N.W.	113	2 0	56.5	2 40	42.3	2 0	56.5
Bradford	G.N.	193½	4 15	45.4	4 50	39.9	3 56	49.1
Bradford (Exchange)	G.C. and L. and Y.	208	4 54	42.4	5 0	41.6	4 42	44.2
Bradford (Market-street)	Midland	203½	4 42	43.2	5 55	34.3	4 13	48.2
Brighton	L. B. and S.C.	51	1 0	51.0	1 15	40.8	1 0	51.0
Bristol *vid* Box	G.W.	118½	2 0	59.1	2 19	51.0	2 0	59.1
Bristol *vid* Badminton	G.W.	117½	2 0	58.8	2 15	52.2	2 0	58.8
Bournemouth	L. and S.W.	108	2 15	48.0	2 39	40.7	2 0	54.0
Cambridge	G.E.	55½	1 18	42.8	1 19	42.3	1 11	47.1
Cambridge	G.N.	58	1 25	40.9	1 26	40.4	1 15	46.3
Cardiff	G.W.	145½	2 53	50.4	3 10	45.9	2 50	51.2
Carlisle	L. and N.W.	299½	6 3	49.4	6 45	44.3	5 50	51.3
Carlisle	Midland	308	6 23	48.2	7 28	41.2	6 5	50.6
Chester	L. and N.W.	179½	3 39	49.1	4 0	44.8	3 32	50.7
Chester	G.W.	195	4 20	45.0	5 5	38.3	4 13	46.2
Coventry	L. and N.W.	94½	1 39	57.1	2 9	43.8	1 43	54.9
Cromer	G.E.	138	3 47	36.4	4 2	34.2	2 55	47.5
Cromer	G.N.	160½	4 26	36.1	—	—	3 58	40.4
Darlington	G.N. and N.E.	232	4 40	49.7	5 0	46.4	4 27	52.0
Derby	Midland	128½	2 27	52.4	3 3	42.1	2 18	55.8
Doncaster	G.N.	156	3 6	50.3	3 31	44.3	2 54	53.7
Dover (Pier)	S.E. and C.	76½	—	—	—	—	1 30	51.0
Dover (Marine)	S.E. and C.	78	1 43	45.4	2 29	31.4	—	—
Edinburgh	East Coast	392½	8 30	46.1	9 40	40.6	7 45	50.5
Edinburgh	West Coast	400½	8 40	46.1	—	—	8 0	50.0
Edinburgh	Midland	407	9 9	44.4	—	—	8 35	47.4
Eastbourne	L.B. and S.C.	60	1 30	43.9	1 47	37.0	1 25	46.5
Exeter (St. David's)	G.W.*	173½	3 0	57.8	3 30	49.6	3 0	57.8
Exeter (Queen-street)	L. and S.W.	171½	3 25	49.9	3 57	43.4	3 11	54.0
Fishguard*	G.W.	261½	5 40	46.0	6 10	42.4	5 30	47.5
Fleetwood*	L. and N.W.	229½	5 15	43.7	5 45	39.6	4 45	48.3
Folkestone (Central)	S.E. and C.	70	1 25	49.4	2 0	35.0	1 23	49.6
Glasgow	West Coast	401½	8 30	47.2	9 30	42.2	8 0	50.1
Glasgow	Midland	424½	9 5	46.7	10 40	39.7	8 45	48.4
Glasgow	East Coast	439½	9 45	45.1	—	—	9 20	47.1
Gloucester	G.W.	114	2 30	45.6	2 54	39.3	2 30	45.6
Halifax	G.N.	201½	4 34	44.1	5 24	37.2	4 6	48.6
Halifax	Midland	206½	4 51	42.5	—	—	4 12	47.4
Harrogate	G.N.	204	4 40	43.7	5 20	38.2	4 0	50.7
Harrogate	Midland	214½	4 55	43.5	6 5	35.2	4 30	47.6
Hastings	S.E. and C.	62	1 30	41.4	1 54	32.1	1 32	39.7
Hastings	L.B. and S.C.	76	2 3	37.2	2 16	33.6	1 58	38.6
Heysham*	Midland	269½	6 25	42.0	—	—	5 47	46.5
Holyhead*	L. and N.W.	263½	5 35	47.1	6 15	42.1	5 15	50.1
Hull	G.N.	196½	4 22	45.0	4 55	40.0	3 52	50.8
Inverness	West Coast	567	14 10	40.0	15 55	35.6	12 50	44.2
Inverness	East Coast	558½	14 30	38.5	—	—	12 40	44.1
Ipswich	G.E.	68½	1 28	46.8	1 30	45.8	1 24	49.1
Leeds	G.N.	185½	4 0	46.4	4 32	40.9	3 25	54.3
Leeds	Midland	196½	3 55	50.1	4 47	41.0	3 40	53.5
Leicester	Midland	99	1 47	53.5	2 15	43.9	1 45	56.5
Leicester	G.C.	103	1 49	56.7	1 56	53.2	1 49	56.7
Liverpool	L. and N.W.	192½	4 0	48.0	4 45	40.4	3 35	53.6
Liverpool	Midland	220	4 50	45.5	—	—	4 25	49.8
Manchester	L. and N.W.	188	4 0	47.1	4 35	41.1	3 30	54.0
Manchester	Midland	189½	3 56	48.1	5 8	36.9	3 40	51.2
Manchester	G.C.	212½	4 25	48.0	4 45	44.6	4 10	49.4
Margate	S.E. and C.	74	1 30	49.3	2 3	36.0	1 30	49.3
Newcastle-on-Tyne	G.N. and N.E.	268½	5 39	47.5	5 55	45.3	5 13	51.4
Newport (Mon.)	G.W.	133½	2 32	52.6	2 45	48.5	2 30	53.3
Northampton	L. and N.W.	65½	1 14	53.3	1 23	47.5	1 18	50.5
Norwich	G.E.	115	2 37	42.9	3 54	30.6	2 17	49.9
Nottingham	Midland	123½	2 15	54.8	2 55	42.1	2 12	56.1
Nottingham	G.C.	126½	2 16	55.8	2 27	51.6	2 19	54.6
Oxford	G.W.	63½	1 10	54.4	1 18	48.8	1 7	56.8
Perth	West Coast	449½	9 45	46.1	11 5	40.5	9 0	49.9
Perth	East Coast	440½	10 10	42.9	—	—	8 58	47.3
Perth	Midland	454½	11 45	38.6	—	—	9 50	46.2
Penzance	G.W.	305½	6 30	46.9	7 55	38.5	6 35	46.3
Portsmouth (Town)	L. and S.W.	73½	1 58	37.5	2 12	33.5	1 46	41.5
Portsmouth (do.)	L.B. and S.C.	85½	1 56	44.3	2 33	33.6	1 58	43.6
Plymouth (North-road)	G.W.	225½	4 7	54.8	5 0	45.1	4 7	54.8
Plymouth (North-road)	L. and S.W.	230½	5 40	40.7	5 55	39.0	4 43	48.9
Rhyl	L. and N.W.	209½	4 39	45.0	4 55	42.5	3 58	52.7
Salisbury	L. and S.W.	83½	1 35	52.8	1 43	48.7	1 31	55.1
Scarborough	G.N. and N.E.	230½	5 10	44.5	5 48	39.6	4 42	49.0
Sheffield	Midland	158½	3 17	48.2	4 1	39.4	3 0	52.8
Sheffield	G.N.	161½	—	—	—	—	2 58	54.5
Sheffield	G.C.	164½	3 0	53.1	3 22	48.9	2 57	55.8
Shrewsbury	G.W.	152½	3 11	48.0	3 42	41.2	2 59	51.1
Shrewsbury	L. and N.W.	162½	3 28	46.9	—	—	3 10	49.8
Stoke-upon-Trent	L. and N.W.	146	2 50	51.5	3 21	43.5	2 41	54.4
Stranraer*	L. and N.W.	403½	9 40	41.7	10 30	38.4	9 45	41.4
Southampton (West)	L. and S.W.	79½	1 32	51.6	1 43	46.1	1 37	48.8
Swansea	G.W.	191	4 10	45.8	4 35	41.6	4 3	47.1
Torquay	G.W.	199½	3 40	54.4	4 35	43.5	3 38	54.9
Weymouth	L. and S.W.	142½	3 24	42.0	3 59	35.8	3 5	46.2
Weymouth	G.W.	154½	3 20	46.2	3 45	41.1	3 10	48.6
Wick	West Coast	729	21 30	33.0	23 40	32.1	20 8	36.2
Worcester	G.W.	120½	2 10	55.6	3 6	38.8	2 9	56.0
Wolverhampton	G.W.	123	2 24	51.2	2 55	42.1	2 23	51.6
Wolverhampton	L. and N.W.	128½	2 35	49.7	3 20	35.7	2 29	50.2
York	G.N.	188½	3 47	49.7	4 0	47.0	3 35	52.4

* Times by Irish boat or mail trains.

FASTEST, AND LONGEST NON-STOP BRITISH RAILWAY RUNS

TABLE B.—*Fastest Runs on British Railways in* 1921 (*Slip Portions Excluded*).

Company.	Run. From To	Distance.	Time spent.	Average speed.	Quicker than in 1920.
		Miles.	Min.	m.p.h.	Min.
London and North-Western	Birmingham–Coventry	19	19	60.0*	6
Great Western	Paddington–Bristol *vid* Box	118¼	120	59.1	15
Great Central	Princes Risborough–Brackley	27½	29	57.5	1
Caledonian	Forfar–Perth	32½	34	57.3	—
Midland	Kettering–St. Pancras	72	77	56.1	10
North-Eastern	York–Darlington	44½	48	55.3	5
South-Eastern and Chatham	Tonbridge–Folkestone	40½	44	55.2	×
London and South-Western	Basingstoke–Surbiton	35½	39	54.9	×
Great Northern	Grantham–Doncaster	50½	56	54.1	4
Great Northern (Ireland)	Dublin–Drogheda	31½	36	53.0	2
Great Eastern	Shenfield–Rochford†	18½	21	52.1	—
Brighton	Victoria–Brighton	51	60	51.0	—
Glasgow and South-Western	Dumfries–Kilmarnock	58½	69	50.6	5
Lancashire and Yorkshire	Liverpool–Manchester	37	45	49.3	—
Great Southern and Western	Maryborough–Dublin	51	63	48.5	—
North British	Edinburgh–Glasgow	47½	60	47.2	—
Great North of Scotland	Huntley–Aberdeen	40½	54	45.0	—
Highland	Blair Athol–Perth	35½	50	42.3	—

* This is both the first occasion on which the London and North-Western Railway has headed the speed table and the first on which it has recorded a run at 60 miles an hour. This run is performed by two trains, the 12.45 p.m. and 6.20 p.m. from Birmingham to London in two hours. It should be noted that none of the pre-war two-hour expresses between London and Birmingham made an intermediate stop. × *New run since* 1920. — No change. † The most meritorious Great Eastern run is Liverpool-street to Parkeston Quay, 69 miles, in 82 min., speed 50.4 miles per hour.

TABLE C.—*Longest Non-stop Runs on British Railways in* 1921.

Company.	Run. From To	Distance.	Time spent.	Average speed.	Quicker than in 1920.
		Miles.	Min.	m.p.h.	Min.
Great Western	Paddington–Plymouth	225¾	247	54.8	16
London and North-Western	Euston–Crewe	158	177	53.5	16
Midland	St. Pancras–Nottingham	123¼	135	54.8	10
North-Eastern	Newcastle–Edinburgh	124¼	147	50.8	3
Great Eastern	Liverpool-street–Beccles†	109¼	147	44.5	1*
Great Central	Marylebone–Leicester *vid* Wyoombe	107¼	114	56.5	9
Great Northern	King's Cross–Grantham	105½	121	52.3	3
Caledonian	Glasgow–Carlisle‡	102¼	155	39.6	—
Glasgow and South-Western	Kilmarnock–Carlisle	91¼	113	48.4	12
London and South-Western	Salisbury–Exeter	88	104	50.7	13
Brighton	Victoria–Fratton	84¼	111	45.6	—
South-Eastern and Chatham	Victoria–Dover (Marine)	78	103	45.4	—
North British	Aberdeen–Dundee	71¼	99	43.2	×
Somerset and Dorset	Bath–Poole	67¼	101	40.0	×
Great Northern (Ireland)	Dublin–Dundalk	54¼	63	51.7	1
Great Southern and Western	Maryborough–Dublin	51	63	48.5	—
Midland Great Western	Mullingar–Dublin	50¼	74	40.4	4*

* Minutes slower. × New run since 1920. — No change. † The Liverpool-street–North Walsham run of 130 miles was not resumed this summer, but at the height of the holiday season, when the 12.30 p.m. Cromer express was duplicated, the first portion ran from London to Gunton, 133¾ miles, without stop. ‡ Fastest journey between these places takes 140 min., but not a non-stop run.

An Omnibus Overhauling Depot.

WITH the object of concentrating the work of overhauling its vast fleet of motor omnibuses in one building, the London General Omnibus Company, Limited, has recently erected a large works just off the Chiswick High-road and opposite Gunnersbury Station. Operations were started in these works during last autumn in some of the departments, and the whole organisation has got into full swing within the past few weeks. Some idea of the magnitude of the undertaking may be gathered from the facts that the new establishment has taken over the whole of the work previously done at three other depôts, that some 2200 hands are employed, and that at least fifteen omnibuses are pulled to pieces and re-erected daily. Besides this work, a large amount of overhauling on unit parts is done in order to keep the various garages of the company furnished with spare parts. In the case, for instance, of a vehicle arriving at one of the garages with a defective engine, the whole engine is lifted off and is replaced by one taken out of the local store. The faulty engine is then sent to Chiswick for overhaul, and a new one taken into stock in its place. The same procedure is carried out with axles, steering gear, and all the other separable parts of the chassis.

It should be understood that no actual manufacturing is carried on at Chiswick, except for a small proportion of coach work, and that the activities of the works are almost entirely confined to making good the effects of wear and tear, so that the vehicles may always be able to pass the very rigid inspections imposed by the licensing authorities and the police. The work is, of course, facilitated by the uniformity in the design of the vehicles, as they have all been built by the Associated Equipment Company, and there are, at present, only three types—"B," "K," and "S," going through the shops. This uniformity permits a very thorough organisation being developed, and the scheme of work is planned on the same broad lines as those of a mass production factory. Many of the processes are, in fact, carried out in the manner typical of such factories as the Ford works in America; but it is noteworthy in the Chiswick shops that the ruthless policy of scrapping, which is prevalent in America, does not appeal to English engineers, and that considerable ingenuity has been exercised in adapting existing appliances to perform new functions economically.

Before going on to describe the works themselves, it may be interesting to mention that we have discussed at some length, with the departmental managers, the attitude of the men towards the mass production system, and gained the impression that they were quite content with the scheme, while it is, we were told, practically the only means of inducing the men to produce the necessary output. The wages are all paid on the time basis, and the foremen and charge-hands find little need to urge their men to greater efforts.

The works, as will be seen from the aerial view—Fig. 1—are covered by one roof, split up into nine bays. This building measures 857ft. by 352ft., and is of steel frame construction with a corrugated asbestos roof and concrete slab walls. It stands back from the main road some little distance with a football field in front. The building seen in the foreground with a clock tower is the canteen, where over a thousand can sit down to meals at one time, while the building facing it across the entrance road houses the main offices. Behind the canteen a big pit has been dug to enable a road to be laid with a gradient of 1 in 14 for the purpose of testing the hill-climbing capacities of the machines after they have been overhauled. The chimney seen in the background belongs to three Economic boilers which are used to provide steam, at about 80 lb. pressure, for heating the buildings. In the shops the heating is carried out on the plenum system with hot air, while the offices, &c., are heated by radiators. Electric current for lighting and power is provided from the Lot's road plant and, at the time of our visit, was actually tapped off the live rail of the railway running behind the works. A transformer is, however, being installed so that a distinct supply may be taken. There are in the works motors aggregating over 1200 horse-power.

FIG. 1—CHISWICK OMNIBUS OVERHAULING DEPOT

As we have already suggested, the major part of the work carried out at the factory comprises the overhauling of motor omnibuses which are not entirely crippled. They thus are brought to the works by their own engines and are driven round to the westerly end of the building, which is on the left hand side, as shown in the plan view—Fig. 2. Here there is a fair sized concrete paved yard where the fastenings that connect the body and the chassis are loosed, the life-guards between the wheels are taken off and all the equipment removed. The vehicle is then backed, by its own power, into the second door in the end of the building, and is brought over a lift for removing the body. This lift, which is shown in Figs. 8 and 9, page 130, is of the hydraulic type, and is operated by a motor-driven oil pump. Two 6in. channels, one on either side of the lift, are carried by the rams and are equipped with short horizontal rods which are slid under the sides of the body when the vehicle has been manœuvred into place. The rams then lift the body to such a height that the chassis can be driven away again. The chassis is taken to the other end of the works and its subsequent adventures will be dealt with later in this article.

The body is held suspended by the lift, and a Ransome electric truck is run beneath it and takes the weight. The cushions are all taken out and sent to a cleaning and repairing shop—see Figs. 6 and 10—while the enamelled iron advertisement plates are removed for smartening up. The electric truck then takes the body along to the body shop, where it is lowered on to a pair of trestles and the electric truck returns to the lift. In this condition the body weighs somewhere about 30 cwt. It is naturally a rather bulky affair, and is thus kept in its allotted position until it is ready for painting. The men, however, move from body to body, and concentrate their attentions on one individual part of the structure. For this reason they have little joiner's benches with wheels on two of the legs, which they wheel about from body to body as they complete their work. The bench stands across the front of the omnibus, but as the chassis has been removed, there is a gap below the front window of the body, and access to the interior can be obtained from either end.

The repairs which have to be carried out on the bodies are very varied in their character, and sometimes entail quite a large amount of work, but there are certain features which require chronic renewal. For these cases some simple yet ingenious jigs have been evolved. Thus there is a dummy roof to which all the hand-rails, &c., can be fitted before they are finally put in place. In this connection we noticed that the rail guarding the staircase to the top decks is of solid brass tube, about No. 11 B.W.G., and asked why so expensive a form should be used. We were told that other types of tube, such as brass-cased and electro-plated, had been tried, but were found unsatisfactory as the surface tended to peel off, and then claims for damage were made by passengers whose hands or clothing were caught by the uneven surface. The rails along the sides of the top deck are of solid

aluminium, and are painted. All the joints in the rails are made by welding with the acetylene blow-pipe.

Jigs are also arranged for assembling the parts of the seats, the back steps, the gratings, &c., so that a very large part of the work may be done by semi-skilled labour. The electrician's department overlaps into the body shop, and the interior wiring of the bodies is attended to while they are on the trestles. They are also given a priming coat of paint, and any screw holes are stopped before the bodies are moved, by the electric truck, into the paint shop.

In the corner of the body shop which laps round the end of the paint shop—see Fig. 2—a certain amount of constructional work is done on the building of the new "K" type bodies. The frames of these bodies are built up of members comprising a sheet steel centre piece, of No. 14 or No. 16 gauge, with ash wood stiffeners screwed on to either side. Gusset plates are introduced at the junctions, and bolts take the place of the screws. In some pieces, such as the backs of seats, it is not necessary for the steel centre to extend the whole length, and then a slot is cut in the wood for the accommodation of the plate by a circular saw. In the preparation of the steel work for these frames the acetylene blow pipe is employed extensively, and there is hardly any smithing work in the ordinary sense of the term; but the older "B" type bodies necessitate a certain amount of smithing as the ironwork is much more heavy.

On scanning one of the new type of bodies we commented on the apparent lack of rigidity for withstanding the fore and aft stresses caused by the inertia of the top deck load during acceleration or braking, but were informed that no trouble is experienced on this account, although there is no diagonal bracing above the side panels. The only place where the body suffers from this cause is, we were told, just above the clutch. If the driver lets the clutch in carelessly the main frames buckle upwards slightly at this point and put a racking stress on the body. The frames, by the way, are now always made with double steel flitch plates and an ash wood core, as this form has been found to give far better service than the channel frame.

In connection with the body shop there is an extensive saw-mill—Fig. 11, page 130—equipped with machinery by J. Sagar and Co., of Halifax. In this mill all the woodwork required in the factory is prepared to such an extent that hardly any hand joinery is required. Behind the saw-mill there is an outhouse where the life-guards, or fenders between the road wheels of the omnibuses, are overhauled and put in order. Associated with the body shop there is also a tinsmiths' shop where the lamps are made up and light sheet metal work is done.

The paint shop, as will be seen from the plan, is entirely walled off from its surroundings, in order to keep it as free from dust as possible. The painting is done by hand, with brushes, and it requires three days to give a body five coats of paint. The overhauled chassis are also brought just inside the shop, and are painted black all over by the spraying system—see Fig. 12, page 130. The chassis and the body are then taken to a lift, very similar to that used originally to lift off the body, and the two are bolted together. The mountings are then added, and the vehicle goes away for its final test and inspection.

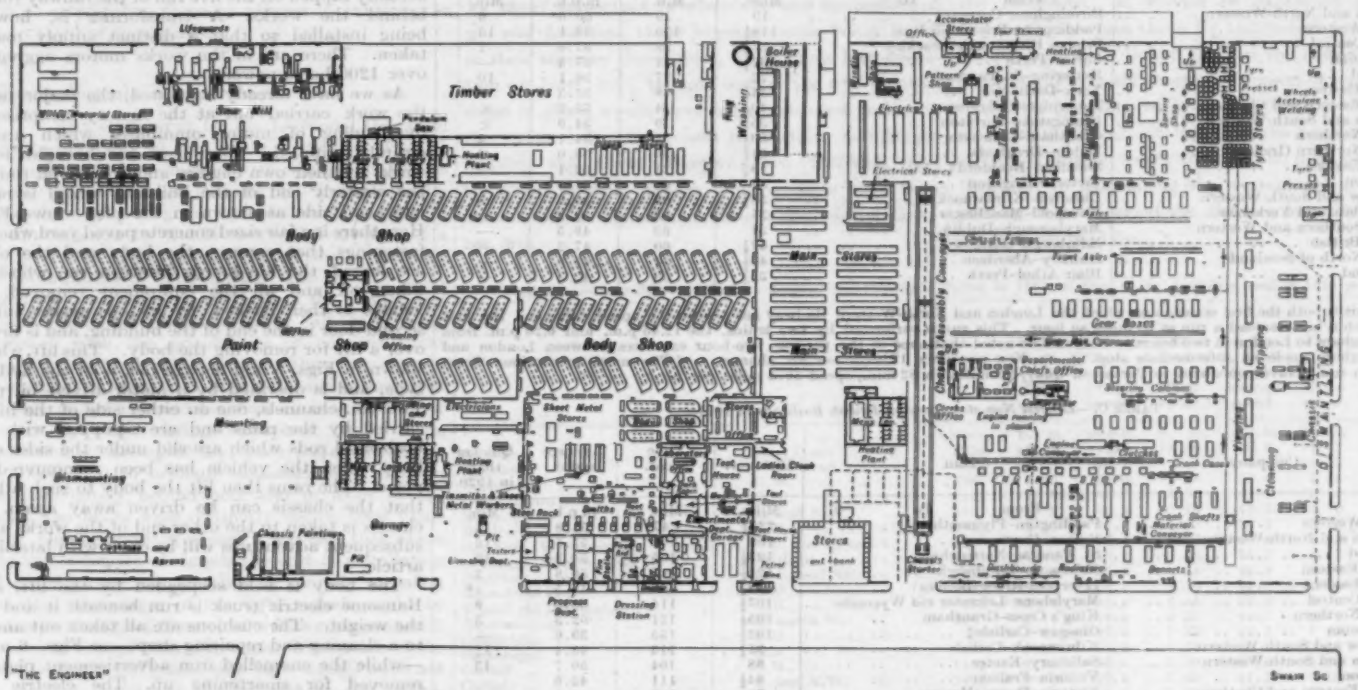


FIG. 3—GENERAL ARRANGEMENT OF LONDON GENERAL OMNIBUS COMPANY'S OVERHAULING DEPOT

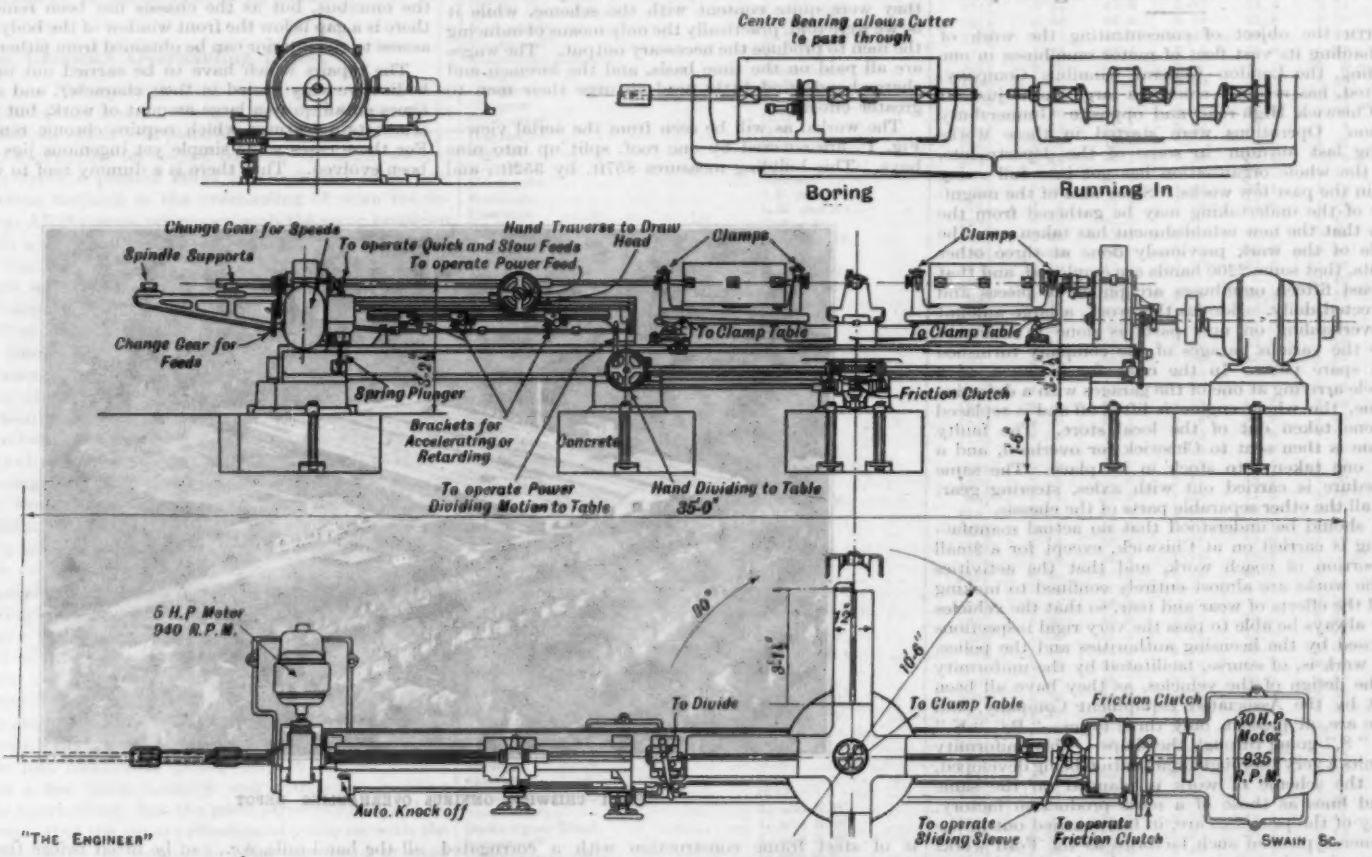


FIG. 3—MACHINE FOR REAMERING MAIN BEARINGS AND RUNNING-IN CRANK SHAFTS

While the body has been going through its renovation the chassis has been driven round the back of the works and arrives in front of the building at the opposite end. It is driven inside and labourers immediately start to dismantle it by stages. First the radiator, bonnet and dashboard are taken off. Then the engine, which is followed by the steering gear and the gear box. As each part is dismantled the chassis is pushed forward, until the two axles, with their wheels are taken away, when the frame is picked up by an overhead runway.

As each part is lifted off the chassis, it is passed to the lift and is given a thorough cleaning. At present a large part of this cleaning is carried on in tanks of boiling soda water, but a special machine for the purpose has been made in the works and will probably supersede the tank system. The first of these machines, which is shown in Fig. 5, is at work and consists, essentially, of a chain conveyor running through a tunnel over the top of a large tank. As a lining to the tunnel there are spray pipes which are supplied with hot soda water by an Albany pump. The articles to be cleaned are put in wire trays on one end of the conveyor and emerge at the other end quite free of grease. The dirty water is filtered continuously and used over again, while the grease is skimmed off the surface of the tank.

All the parts, as soon as they have been cleaned, are passed on to the left where a number of skilled men inspect them. Any part which is really badly worn is scrapped forthwith, while the better pieces are sent forward for renovation.

The radiators, dashboards, silencers and so forth, which were first taken off the chassis, travel across the shop, just inside the front of the building, on the conveyor shown in Fig. 13, page 130. Alongside this conveyor, which travels quite slowly, there is a range of benches and smiths' hearths where the bent parts are straightened up and generally put in order. The soldered joints of the radiators are cleaned by dipping in an acid bath, and then made good by dipping in molten solder, while aluminium castings, such as the gear covers, are brightened up by being dipped in *aqua fortis*. In this department there are also a couple of hand-operated die-casting machines for re-lining the crank shaft bearings. There are several welders, using acetylene blow-pipes, and a few odd machines, such as a lathe, a grinder, &c., so that the department is self-contained, and the men may have no need to run about the shop to keep their gear in working order. The overhauled material goes forward on the conveyor and is stacked up at the end ready for re-assembly.

In the next bay of the shop the engines are attended to. The chief operations are grinding out the bore of the cylinders and trueing up the crank shafts. In both cases the grinding is carried on till a definite size has been arrived at. That is to say, the grinding is not necessarily only just sufficient to clean up the wear marks, but must bring the shaft, or cylinder, to a definite size, which is designated by a standard number. There are four Landis grinders for the crank shafts, and as the shafts are completed they are put in rotating racks according to their standard number. The cylinders are dealt with in much the same way, the valves are re-ground, and all the various parts gradually progress towards the engine conveyor, which runs down the centre of this department and is shown in Figs. 14 and 15, page 137.

Experience has shown that the aluminium crank cases warp out of shape quite perceptibly in service, with the result that the crank shaft bearings get out of line. At one time the bearings were lined up and the shaft bedded in by hand. This work occupied a skilled fitter for a whole day, and the engineer at the works thus cast about for a means of expediting the operation. He has been so successful that the time has been reduced to 20 minutes. The work is now carried out on the machine shown in Figs. 3 and 16, page 137, which was made to the designs of the engineer by John Holroyd and Co., Limited, of Milnrow, near Rochdale.

The essential features of this machine are a star-shaped rotating table on which four jigs are mounted, a boring bar, and a driving gear for finally bedding in the crank shaft.

Before arriving at this machine the crank cases have had their horizontal joints ground true on a large rotating face plate. They are then mounted in the jigs, upside down. At either end of the jig there is a bearing for the boring bar, while a steady rest is arranged about midway between the bearings. This steady is secured to the jig through one of the cylinder openings and has an ingenious mechanism, so contrived that it may open out to pass the cutter as it travels along and then close up behind it again. The boring bar is run right through the crank case, and is fitted with a reamer corresponding to the standard size of crank shaft which is coming forward. It is attached to the spindle of the boring mechanism by means of a flexible coupling, so that the alignment is maintained by the jig rather than by the spindle, and the feed draws the reamer back towards the driving head. There are three main bearings to reamer out in each crank case and the feed mechanism is so arranged that the reamer has a quick traverse between the bearings. Only one pass with the reamer is necessary and the star table is then turned through 90 deg. A crank shaft is put in place, and the table turned again. When the jig arrives in the third position the crank shaft is coupled up with a 30 horse-power motor and rotated for about twenty minutes while the bearings are gradually tightened down. They are, of course, copiously lubricated during this process and are thoroughly bedded down. The table having been turned through another right angle the crank case is removed and another put in its place.

Another ingenious machine which has been devised for grinding in the inlet and exhaust valves of the engines is shown in Figs. 4 and 7. In this machine an effort has been made to reproduce, as nearly as possible, the action of grinding in a valve by hand, which is, of course, generally considered to be the most satisfactory method, and the inventor has secured a motion as similar as is possible with mechanical means.

The machine is provided with a set of vertical spindles, which act as drivers for the valves and engage with slots in their tops in the same manner as screw drivers. These spindles are turned for about one revolution and then reverse, but the position where the reversal takes place is constantly changing, so that there is no fear of the valves or seatings being ground into grooves. The valves are also occasionally lifted off their seats and dropped again to ensure an even distribution of the grinding material.

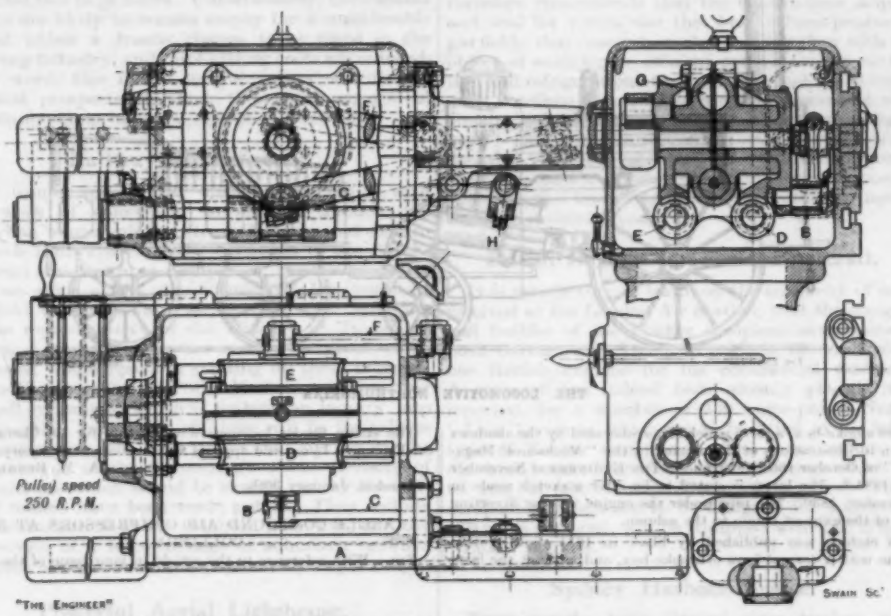


FIG. 4—DRIVING GEAR OF VALVE GRINDING MACHINE

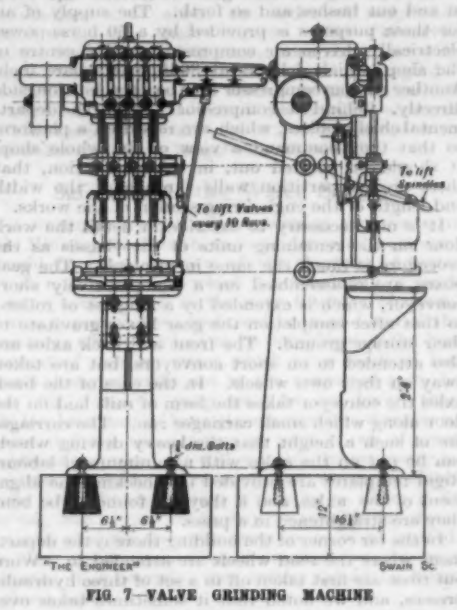


FIG. 7—VALVE GRINDING MACHINE

FIG. 5—COMPONENT PARTS WASHER

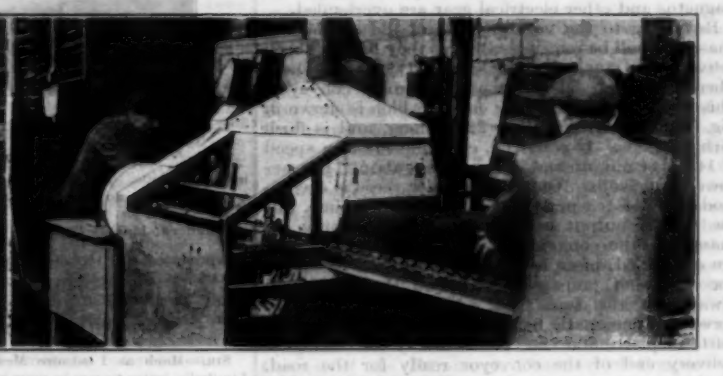


FIG. 6—CUSHION BEATER

The peculiar movement of the driving spindles is produced by a horizontal rack, which gears with pinions on the tops of the spindles. This rack is shown at A in Fig. 4, and it is given a compound movement that reciprocates it through a comparatively short stroke, for the purpose of rotating the valves, while, at the same time, it moves backwards and forwards bodily at a much slower rate. On referring to Fig. 4, it will be seen that a crank B and connecting-rod C work the rack. The crank, in turn, is driven by the worm and worm wheel D, which are connected with the belt pulley on the left. If the crank shaft were fixed this crank would give the rack a simple reciprocating motion, which is not desired. The crank shaft is thus moved backwards and forwards so that the rack is reciprocated and also gradually creeps back and forth. This superimposed

movement is produced by the worm wheel and worm E. This wheel, which is of much finer pitch than the other one, also has a crank and connecting-rod F, but this connecting-rod is anchored to the casing of the machine. The carriage in which the two worm wheels are mounted is free to slide within the casing on two guide bars G G. It will be readily appreciated that as the connecting-rod F is held by the casing the worm wheel carriage must move backwards and forwards under the influence of the worm E, and the creeping motion is thus provided. The occasional lifting of the valves off their seats is effected by the bell crank H, the upper arm of which is struck by a projection on the ram when it moves to its extreme position on the left.

The remainder of the machinery in the engine shop is of a normal character; but it is noteworthy that pneumatic tools are used very largely for such jobs as drilling, reamering, driving screws, pressing in and out bushes and so forth. The supply of air for these purposes is provided by a 50 horse-power electrically driven air compressor, in the centre of the shop, which delivers at 80 lb. per square inch. Another similar compressor is to be installed alongside directly. Behind the compressor there are the departmental chief's offices, which are raised on a platform so that they command a view of the whole shop. It should be pointed out, in this connection, that there are no partition walls throughout the width and length of the engineering section of the works.

It is not necessary to describe in detail the work done on the remaining units of the chassis as the procedure is much the same in principle. The gear boxes are re-assembled on a comparatively short conveyor, which is extended by a long set of rollers, so that after completion the gear boxes gravitate to their storage ground. The front and back axles are also attended to on short conveyors, but are taken away on their own wheels. In the case of the back axles the conveyor takes the form of rails laid on the floor along which small carriages run. The carriages are of such a height that the heavy driving wheels can be put on the axles with a minimum of labour. Rigid templates are provided for checking the alignment of the axles, and if they are found to be bent they are straightened in a press.

In the far corner of the building there is the department where the road wheels are attended to. Worn out tires are first taken off in a set of three hydraulic presses, and we noted that it sometimes takes over 80 tons to force off a tire, while it only required some 30 tons to put on a new one. A number of acetylene welders are stationed in this department to patch up faulty wheels. Repairs are made on the wheels without the whole wheel being given a preliminary heating, and we were told that the method has proved quite satisfactory.

Next to the wheel department there is the spring shop, where the springs are made by skilled smiths. A large furnace—Fig. 17, page 137—heated by gas taken from the town mains is used for heating the springs and they are tempered in water. Every spring is tested in an Avery machine—Fig. 18, page 137—and loaded until it is flattened right out, which requires some 32 cwt. for a front spring. If the spring shows any permanent set immediately after testing it is scrapped.

Beyond the spring shop there are the millwrights' tool room, which has quite an extensive equipment of machines, and the electrical department, where magnetos and other electrical gear are overhauled.

Reverting to the various parts of the overhauled chassis, it will be remembered that they have all been delivered and stacked on the left-hand side of the shop, where they lie beside the chassis assembly conveyor. This conveyor, the delivery end of which is shown in Fig. 19, page 137, is some 220ft. long, and is flush with the floor. It is moved, continuously at a speed of 14in. per minute and only requires about 1½ horse-power to drive it. On this conveyor there is accommodation for ten or twelve chassis at one time, but the normal output can be obtained with only six chassis on the conveyor at one time. The chassis are assembled, piece by piece, as they pass alongside the stocks of prepared parts, and the same men always do the same job. An overhead runway served by pneumatic hoists is used to put the heavy parts in place, and the chassis finally arrives at the delivery end of the conveyor ready for the road. In this position it stands with its wheels on the rollers in the floor seen in the foreground of Fig. 19. These rollers are driven by an electric motor and start the engine, a man takes the steering wheel and drives the chassis away. If, during a drive round the works any minor defect is discovered, the chassis is taken to a garage in the front centre of the building and the fault rectified. Then, after being passed as in order, it goes to the other end of the works to pick up a body as described earlier in this article.

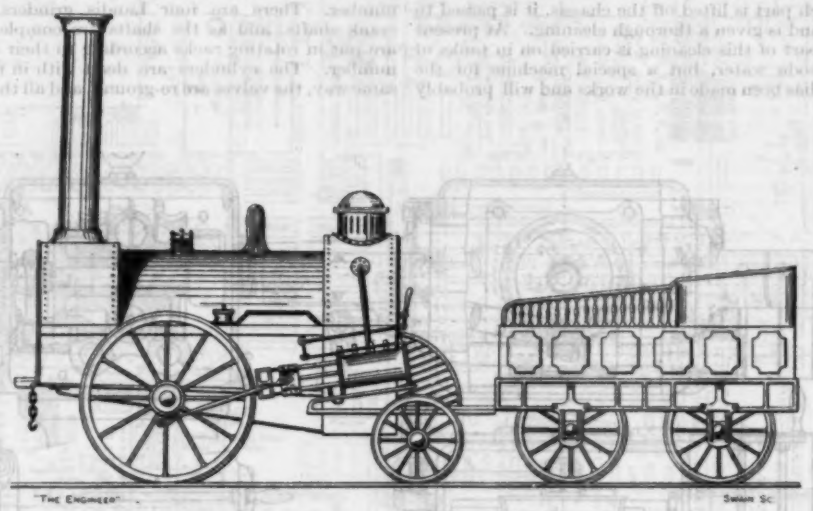
IN the opinion of the chairman of the Great Indian Peninsula Railway, as expressed when speaking on the Heworth report at the meeting of that company on January 20th, the position of the Indian company-worked railways cannot materially be altered for the better until there has been a very large expenditure on equipment, on necessary renewals and, in course of time, on much-needed extensions.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

LIVERPOOL AND MANCHESTER LOCOMOTIVES.

SIR,—I enclose photographs of a jug in my collection bearing a representation of the opening procession on September 15th, 1830. It will be noticed that the Northumbrian is drawn with a square smoke-box, a form which is corroborated by the shadows shown in illustrations of this engine in the "Mechanics' Magazine" of October 16th, 1830, and in THE ENGINEER of November 7th, 1884.* The latter is stated to be after a sketch made in September, 1830. The pipe under the engine was for diverting part of the exhaust steam to the ashpan.



THE LOCOMOTIVE NORTHUMBRIAN

An etching was published by Shaw in 1831 showing this engine with a normal form of smoke-box, and without the last-mentioned pipe. The figure in a top hat in the front seat of the triumphal car is no doubt intended for the Duke of Wellington.

C. F. DENDY MARSHALL.

Guildford, January 23rd.

*Reproduced in the accompanying line engraving.—ED. THE E.]

SOME POINTS ON MANUFACTURING.

SIR,—Much as I admire Messrs. Austin Motor Company, Limited's, letter to you in your issue of the 20th inst. (page 75), I think that the difference between the English and the American manufacturer is that the American created a market, whereas the English maker is waiting to be "given the demand."

The English manufacturer has at his disposal equal or better engineers, workmen and material. The whole British Empire, as well as the rest of the world, is as good a market as that open to the United States, but there seems to be a lack of confidence here, which is again shown in the number of well-known British engineering firms which are now manufacturing under a foreign licence.

Are the British engineers not to be trusted by the financial world, or is there a lack of knowledge in the present management of our engineering industries? Such backwardness of engineering progress must ultimately make the country a second-rate Power.

T. MORE.

Manchester, January 29th.

LOCOMOTIVES WITH FOUR EXCENTRICS.

SIR,—I beg to refer Mr. James Dunlop to your issues of February 3rd and 10th, 1865, and in an article entitled "French Locomotives" the principal dimensions of the Verpilleux steam tender locomotive are given. This is in the issue of February 3rd. The issue of February 10th contains an outline drawing showing the engine coupled to the tender.

Deghilage, in "L'Origine de la Locomotive," on page 39, gives a description and some dimensions, and on Plate IX. gives an illustration of the locomotive only. This work is written in French, and the measurements are in the metric system. The date of construction is given by Deghilage as 1843; thus Verpilleux would considerably anticipate Sturrock, but your article on "French Locomotives" tends to imply that Sturrock and Verpilleux were contemporaneous.

JUG COMMEMORATING THE OPENING OF THE LIVERPOOL AND MANCHESTER RAILWAY

The steam tender locomotive was made for Le Chemin de St. Etienne à Lyon, and appears to have been satisfactory.

A. M. BUSHELL.

London, January 30th.

ANGLE COMPOUND AIR COMPRESSORS AT A COLLIERY.

SIR,—With reference to the article in your issue of the 27th, under the above heading, and the statement that the makers of the American compressors and motor illustrated and described understand that it is the first in the United Kingdom to be driven by a self-starting synchronous motor, I have to say that a "Belliss" compressor was installed at Messrs. Barclay, Curle and Co.'s Stobcross Engine Works in 1919, operated by a self-starting synchronous motor made by the Lancashire Dynamo and Motor Company, and another at one of their shipyards about the same time.

ALBERT CHAS. PAIS, M.I. Mech. E.
(Belliss and Morcom, Limited).

Birmingham, January 31st.

[The Lancashire Dynamo and Motor Company, Limited, has written to us to a similar effect. There is, therefore, very little doubt that the Sullivan Machinery Company was labouring under a misapprehension when it suggested that its installation of compressor plant at Bowden Clune Colliery was the first in the United Kingdom to be driven by a self-starting synchronous motor. In the article we, of course, made it quite clear that the suggestion advanced was the Sullivan Company's and not our own.—ED. THE E.]

INSTITUTION OF WELDING ENGINEERS.—Members of the various sections of the welding industry, at an inaugural meeting held January 20th at the Holborn Restaurant, adopted the proposal to form a new Welding Society embracing all systems of welding. A committee, with power to add to its number, representing the different interests, was elected to draft the constitution with a view to registration after approval by a general meeting, which will be called at an early date. The name agreed upon is the Institution of Welding Engineers, and all interested in the welding and allied industries will be eligible for membership. The offices (*pro tem.*) are at 30, Red Lion-square, London, W.C 1, and the hon secretary (*pro tem.*) is Mr. C. Raggett.

A Seven-Day Journal.

Record Clyde Shipyard Output.

IT is an extraordinary occurrence that at a time when the shipbuilding industry is in an unprecedented state of stagnation, and the tonnage of new work is dwindling to exceedingly small figures, the Clyde yards should have put into the water during January a record tonnage for the first month of the year. No fewer than nine vessels, representing over 56,000 gross tons, passed down the ways. These included two large liners. Unfortunately, the vacated berths are likely to remain empty for a considerable period unless a drastic change takes place in the shipping industry, and shipbuilding costs are reduced. In a word, this record output coincides with the blackest prospects of which those now engaged in the shipbuilding industry have any knowledge.

Railway Electrification.

IT would appear that an actual beginning with the work of converting to electric traction the suburban routes of the Great Eastern and South-Eastern Railways—and the extension of the South-Western and Brighton Companies' electric routes, is now an affair of the near future. In his speech at Sheffield the other day, Mr. Arthur Neal, speaking as the representative of the Ministry of Transport, said that negotiations were now in progress which he hoped would result in starting up these schemes. It would seem that Sir Philip Nash is presiding over a small committee which is making an inquiry into the question, and although there will be formalities to comply with, Mr. Neal thinks that success will be the outcome of the committee's work. Details of the schemes which would be carried out by the railways named have been made public. They include the electrification of the Brighton main line, and the conversion of a large mileage of suburban railways to which electric traction is particularly applicable.

Powerful Aerial Lighthouse.

A CONSIDERABLE increase in the range over which aerial lights will be visible will be made when the new light on Mont Afrique, near Dijon, is available. The contemplated power is said to be 1000 million candles, which should make the light visible to high-flying aeroplanes at a maximum distance of over 200 miles under favourable conditions. The range of the existing lighthouses which have been established on the London–Paris route is from 20 to 40 miles. The light on Mont Afrique will exceed in candle-power any of the lights now used for the guidance of shipping.

High-speed Tramway Services.

IN the course of the next few days a number of high-speed tramway cars will be put into service on some of the routes operated by the London County Council. The new cars are very similar in appearance to the existing types, but they are equipped with 60 horse-power motors, whereas the existing cars have only 44 horse-power motors. The lighting and ventilation arrangements have also been improved, and greater protection from the weather has been provided for passengers using the upper deck. Additional safety devices have also been incorporated in the design. Trials have shown that even with a trailer attached the new cars can be driven at the same speed as cars of the old type without trailers. It is assumed that they will be used with trailers in the first instance, as a few high-speed cars sandwiched in with lower-speed vehicles running on the same track would be unable to average a greater speed than that of the lowest speed car, and would have no effect in accelerating the services.

Radium Mining in Cornwall.

WORK is to be resumed on the uranium lodes which are known to exist at the Tolgarrick Mine near Truro. It has been decided to treat the ore for the production of radium *in situ* and thus establish a new branch of the mining industry in Cornwall. The mine was opened up and the lodes proved in pre-war times, but work was abandoned during the period of hostilities. The necessary plant and machinery for the resumption of active operations is, however, on the spot, so that there should be no undue delay in putting the mine into the productive stage.

Helium for Airships.

MUCH interesting matter is contained in the report of the United States Advisory Committee for Aeronautics. The belief in the airship, which is characteristic of American aviation circles, is reflected and confirmation is given to the statement that the United States Government has commissioned the Zeppelin Company to build a ship to take the place of the R 38. The part of the report which has attracted most attention among advocates of the airship in this country is that which deals with the use of helium for purposes of inflation. We are reminded that the natural gas wells in the United States give that country a practical monopoly of the supply of helium, and it is recommended that steps should be taken to conserve these resources, which are being dissipated at a rate which threatens exhaustion within a period of twenty years. It is said that helium is escaping into the atmosphere in quantities sufficient to fill four large airships a week. The report therefore recommends that the Government acquire and seal for future use the best helium-producing gas fields, that research work be undertaken with the object of evolving an efficient process for the extraction and refrigeration of helium, and that the Government continue experimental work in connection with airships. It is stated that many successful flights have been made with an airship inflated with helium, and the intention underlying the recommendation of the Committee's report is that America shall possess resources and knowledge with which no other nation could successfully compete.

British Engines for Foreign Aircraft.

IT is satisfactory to learn, on the authority of news received at the London Air Station, that the designer and builder of the Fokker aeroplane, after tests of both German and American engines, has decided to use British engines for his commercial machines. A contract has indeed been already placed, it is reported, for a number of 450 horse-power Napier "Lion" engines, which are to be fitted to the latest type of Fokker monoplane. The same engine has also been ordered for new French machines which are to run in the London–Paris air service. These aeroplanes, which are to be designed for a speed of 130 miles per hour, will be equipped with two Napier "Lion" engines.

Sydney Harbour Bridge.

FOUR months have elapsed since tenders were invited for the construction of the large cantilever bridge which it is proposed to erect over Sydney Harbour, and surprise has been expressed in some quarters that no bids have yet been made. It appears to have been overlooked that to get out a tender for a work of this description is a labour of many months, and that existing conditions in the materials and labour market and the prospects of a decline in the cost of materials and the wages bill at an early date have added to the difficulty of calculating the cost of a bridge which is to be over 3800ft. in length and wide enough to carry four lines of railway, a motor track and an ordinary roadway and footways. As, however, the date for lodging tenders with the Public Works Department at Sydney has been extended to October 31st next, there is ample time for the few British firms capable of undertaking the work to prepare estimates.

Large Contract for British Firm.

RUMOURS which have been current that a large contract for grain elevating machinery had been secured by Spencer and Company, Limited, of Melksham, have now been confirmed. The contract which has been placed by the Government of South Africa is for an amount between £400,000 and £500,000, and should provide employment for a large number of hands for a period of at least eighteen months. It is understood that the South African Government has framed a comprehensive policy for the development of the agricultural resources of the Union, and that the provision of grain elevating machinery is a feature of the scheme. A large shipping elevator is to be erected at Durban, and another of somewhat smaller capacity at Capetown, and thirty-four will be provided in different districts of the Union. The contract which has now been awarded includes the whole of this elevator programme. It is stated that the order has been obtained in face of continental and American competition.

Imperial Wireless Chain.

THE most interesting part of the report of the Wireless Telegraphy Commission is that which deals with the type of plant to be installed at the various stations. As a result of recent technical developments the recommendation is made that the transmitting stations in England, Canada, Australia, the Union of South Africa, India, and Egypt should be equipped with thermionic valve plant, but that in view of the skilled attention demanded by that apparatus in its present stage of progress, the isolated stations in East Africa, Singapore and Hong Kong should be equipped in the first place for arc transmission, and that the new valve plant should only be added after practice has become standardised. The suggestion to adapt the ex-German station at Windhuk is rejected in favour of an entirely new station near Johannesburg. The Commission also recommends that each transmission station should be capable of working with either of two wave lengths as may be appropriate to the time of day and the atmospheric conditions, and that each receiving centre should be provided with antennæ and apparatus sufficient for working simultaneously with the other stations normally communicating with it. The thermionic valve sets should be capable of transmitting continuously at hand speed and at 90 words a minute at full power for reception at a range of 2500 miles. As the result of an inspection of the valve plant at the Carnarvon station of the Marconi Company, the conclusion has been reached that that installation is of about the order of magnitude required in the chain stations. The Carnarvon station has succeeded in communicating direct with Australia at some hours of the day, and it is regarded as certain that the chain station in England, which would be of three or four times the signalling strength of the Carnarvon station, could communicate with Australia through a longer diurnal period.

Safeguarding the Water Supply.

A NUMBER of experts have been in conference at the Ministry of Health to consider what measures should be taken in view of the shortage of water which now exists, and which is not unlikely to reach a more acute phase in the near future. The committee is essentially a technical body and one of the questions which has had to be considered is the best method of treating water, which as a result of last year's drought might not in the untreated state be safe for domestic purposes. As no fewer than 126 local authorities have given notice of a threatened water shortage the question at issue is one of great public importance. It will not only be necessary to consider methods of treating the water available from the ordinary sources of supply to make it fit for use, but of how far it may be possible for water not now used for domestic purposes to be so treated. In view of the possibility of another drought next summer, it is essential that action should be taken without delay.

Railways and Road Transport.

OPPONENTS of the policy of the railways to obtain extended powers for road transport have been exceedingly active during the past few days following the depositing of Bills by English and Scottish railway interests to obtain powers to conduct independent road transport. A study of the measure which has been deposited on behalf of the North-Western and Midland group suggests that most of the grounds of opposition have been considered, and the necessary safeguards provided. One of the principal objections on the part of existing road transport concerns to the railway companies' proposals is that they would place the railways in a position by rate-cutting tactics to obtain a monopoly of road as well as railway transport. The Bill to which reference is made provides, however, for the control of road rates in railway-owned vehicles being placed in the hands of the Railway Rates Tribunal, which under the Railways Act has the power to reject rates which are uneconomical and would compete unfairly with existing road transport or with coastwise shipping and inland waterways transport. It is stated that the railway companies have no intention to cut rates, but recognising that for certain classes of traffic road transport is cheaper than rail, desire to carry in their own vehicles traffic which was formerly consigned by rail. Motor manufacturing interests are placated by a clause which will prevent the railway companies manufacturing any road vehicles for the new services, so that their invasion of the road arena should give a stimulus to British motor industry. The monopoly argument was again put forward this week at a meeting convened by the Scottish Commercial Motor Users' Association. The application of Scottish railway companies for road powers has also been before the Council of the Edinburgh Chamber of Commerce, and a strong hostile resolution has been carried.

Controlling Aeroplanes in Fog.

TESTS which have been carried out with a system of guiding aeroplanes in fog by means of the reception of impulses from a ground cable are reported to have yielded satisfactory results. The apparatus, which has been designed by Lieutenant Loth, of the French Navy, will, it is believed, enable regular commercial flights to be made under night and fog conditions which at present render air services impossible. The pilot is able by means of the receivers installed on the machine to ascertain his position with remarkable accuracy, and it is understood that a cable will be laid on a portion of the London–Paris route in the near future. Night flying in clear atmospheric conditions will be assisted by the modification of marine lights to suit the needs of aviators, by landing lights, and by the development of improved navigation lights on the machine.

OFFICIAL TESTS OF A NOBEL-DIESEL TWO-STROKE ENGINE. D = 675 MM., s = 920 MM., n = 106 R.P.M., 4-CYL.

MADE BY PROFESSOR A. ROSBORG, STOCKHOLM.

No. of test	1	2	3	4	6*	7	8	9
Date	23/8, 10.30 a.m. to 3.45 p.m., continual run.					24/8, 3.10 p.m. to 5.30 p.m.		
Revolutions per minute .. .. ..

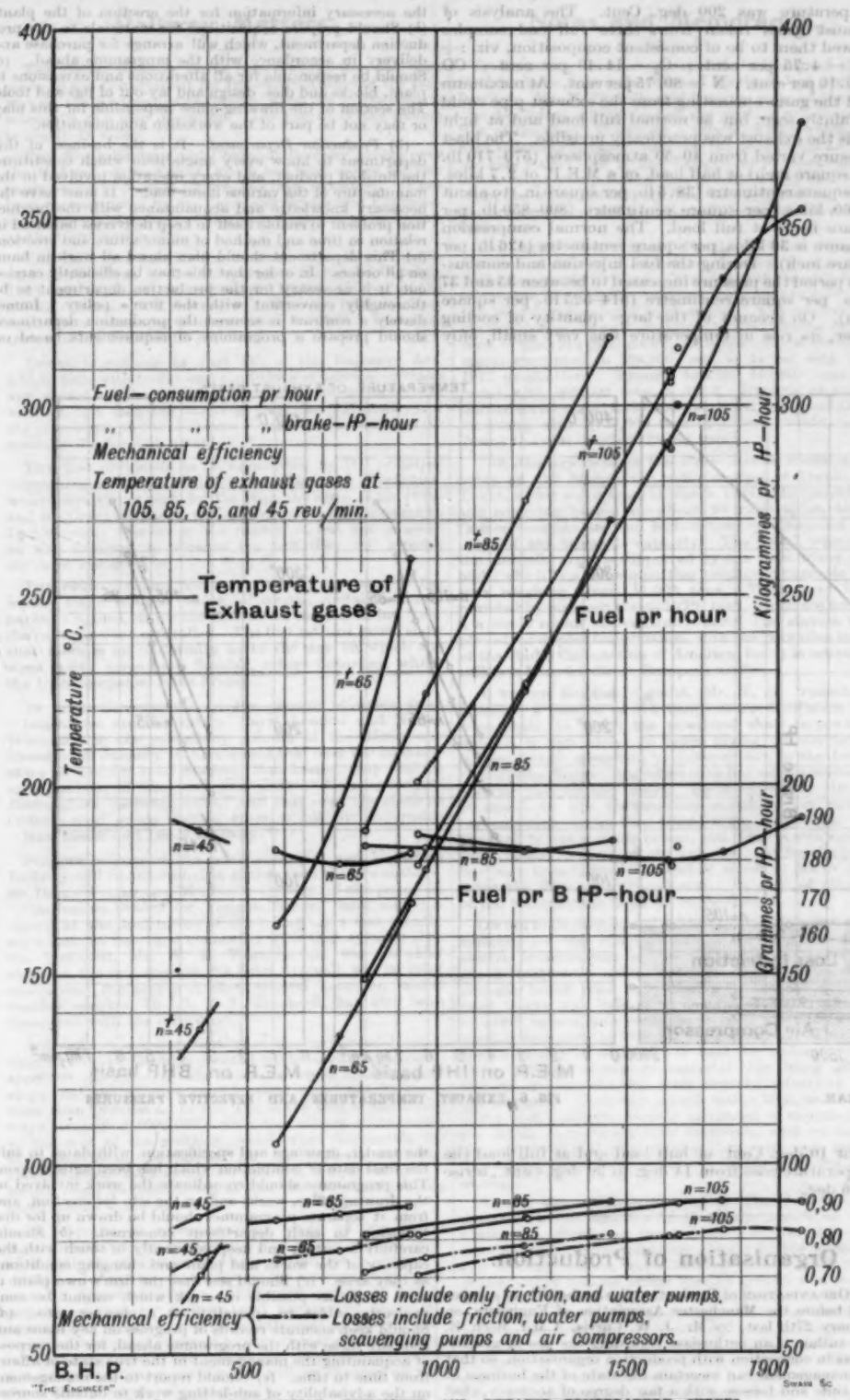


FIG. 2—FUEL CONSUMPTION, EFFICIENCY AND EXHAUST TEMPERATURE CURVES

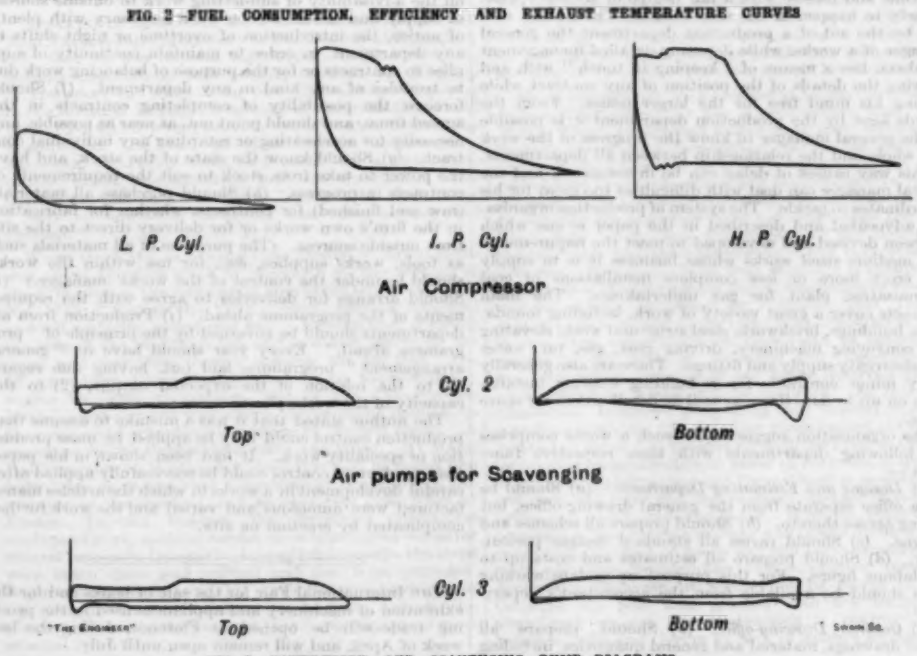


FIG. 3—COMPRESSOR AND SCAVENGING PUMP DIAGRAMS

the following formula:—Brake horse-power $= \frac{P\,n}{180}$ where P denotes the brake load in kilos. at the end of the beam and n is the revolutions per minute of the engine. The dynamometer was checked carefully for accuracy and sensitiveness. For the measurement of the speed, a tachometer was fitted to the vertical shaft, and another similar instrument was connected to the shaft of the dynamometer, which was direct-coupled to the engine. These tachometers indicated the revolutions per minute of the engine directly, whereas from a fuel pump was driven a revolution counter, by means of which the exact mean revolutions per minute for each test could be calculated. The indicators used—of the Rosenkranz standard outside spring pattern—were calibrated before the tests. The indicators were fitted to all the cylinders, scavenging pumps, compressors and air receiver. Indicator diagrams were taken during each test. In Figs. 1 and 3 are shown diagrams of the working cylinders, air compressors and scavenging pumps. Indicated horse-powers were calculated from the diagrams, and are given in the table of trial results. For the measurement of fuel consumption the fuel service tank was placed on a sensitive sliding poise balance, and the tank was connected to the fuel pipe of the engine by a light rubber tube. Stop watches were used to take the time for the consumption of 50, 100 or 200 kilos. of fuel. The fuel consumption per hour was then calculated. The fuel used was a Diesel oil (Galisol), and from the analysis of samples of it made by the Swedish State Testing Laboratory it possessed a specific gravity of .86 at 20 deg. Cent. The calorific value (Lower) was 9960 cal. per kilo., or 17,900 B.Th.U. per pound; flash point, 74 deg. Cent. The temperatures of the engine-room, scavenging air,

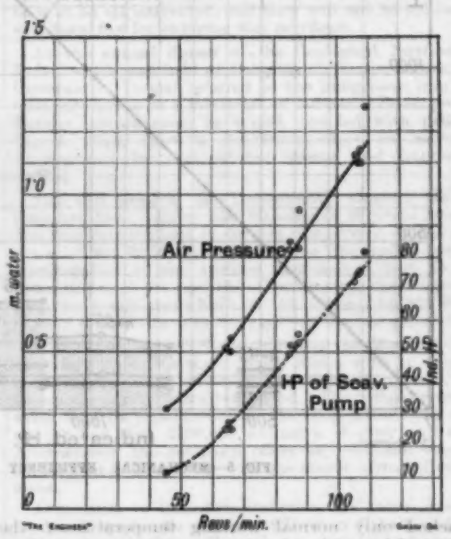


FIG. 4—SCAVENGING AIR PRESSURE AND HORSE-POWER

cooling water and exhaust gases were taken. The scavenging air pressure was measured by means of a water-column gauge, whilst higher air pressures were measured by means of pressure gauges of the Bourdon type, which were calibrated before the trials. All cooling water was collected into a common outlet pipe to which a water meter was connected. Readings were taken during each test. Samples of exhaust gases were collected in glass bottles and analysed by means of an Orsat apparatus.

The object of the tests was to investigate the performance of the engine at various loads and speeds, and also its manœuvring qualities, viz., starting, reversing, slow speed, &c. The programme of the trials was as follows:—August 23rd, 1921, the fuel consumption tests No. 1–6—see table—at different loads and speeds, during a five-hours' continuous run. August 24th, 1921, manœuvring trials and three fuel consumption tests. September 10th and 11th, 1921, twenty-four hours' continuous trial at full load (1600 brake horse-power) and normal speed (105 revolutions per minute). This test was finished with a half-hour's run at an overload of about 10 per cent., whereupon the engine was stopped and the temperatures of bearings, pistons, &c., were measured.

The trials may be summarised as follows:—The engine was quite cold before starting, and it took 2–3 seconds to start the engine by turning it on starting air for 1–2 revolutions. The pressure in the starting air reservoir dropped from 17.75 atmospheres (252 lb. per square inch) to 14.5 atmospheres (206 lb. per square inch), which corresponds to a consumption of starting air reduced to atmospheric pressure of 6.5 cubic metres (230 cubic feet). These results agree very closely with those of previous starting tests of the same engine. After the start the engine worked at full load with perfect regularity. It was reversed from full speed ahead to full speed astern in 8 seconds, also *vice versa* in a similar interval of time. The construction of the dynamometer did not allow the application of load for astern running. By diminishing the fuel supply, the speed of the engine was brought down to 28 revolutions per minute,

and at this speed the engine fired regularly without any inclination to stop. (A few weeks after these trials, when the attendant engineers were more accustomed to the control of the engine, speeds as low as 25 revolutions per minute were easily obtained for continuous periods.) When the load was suddenly thrown off the centrifugal governor prevented racing above 130 revolutions per minute.

Full Load Tests.—During the twenty-four hours' trial the engine worked at 106 revolutions per minute and the output was:—First hour and a-half, 948 brake horse-power; next hour, 1237 brake horse-power; next twenty-one hours, 1620 brake horse-power; last half-hour, 1752 brake horse-power. During this last test the mean effective pressure on a brake horse-power basis worked out at 5.72 kilos. per square centimetre, or 81¼ lb. per square inch. When the engine was stopped after this test it was found that the pistons, cylinders and bearings had reached only normal working temperatures; the hottest big end bearing having a temperature of no more than 45 deg. Cent., or 113 deg. Fah.

On September 14th, 1921, a test, not in the presence of Professor Rosborg, was made by the engineers of the works, with an output of 1958 brake horse-power at 108.4 revolutions for a period of three-quarters of an hour. The fuel consumption (Texas oil) amounted to 191.4 grammes per brake horse-power (.422 lb.). This test is shown on the table of trial results as No. 14. In perusing the above table one notices the remarkably low and steady fuel consumption even at light loads. The figures for full load, when reduced to the standard calorific value of 10,000 cal. per kilo. (18,000 B.Th.U. per pound), are 178–180 grammes per brake horse-power per hour (.393–.397 lb.), and for half load 187 grammes (.413 lb.), thus showing an increase of about 5 per cent. only. The lubricating oil consumption was kept practically constant during all the tests. It was 10 kilos. for three hours, or equivalent to 2.1 grammes per brake horse-power-hour. No special economy in lubricating oil was attempted during these tests, and this accounts for the above figure. The mechanical efficiency or the ratio of brake horse-power to indicated horse-power was as high as 82 per cent. at the highest load, and at half load dropped to 70 per cent. The internal losses of energy in the engine can be divided into three categories: Scavenging pump work, air compressor work, friction (including cooling pump work). Of these the scavenging pump work and friction are practically constant at constant speeds. The compressor work, on the other hand, increases with the increase of M.E.P. on account of higher blast pressure. The pressure of the scavenging air and the work of the scavenging pumps alter considerably with the speed. Nevertheless, the scavenging pressure is very low; at full load (1600 brake horse-power, 105 revolutions per minute) it was only about 1100 mm. of water column (1.6 lb. per square inch). The temperature of the exhaust gases followed regularly the power output or M.E.P., though it was to some extent affected by the speed. The temperature of these gases was as low as 330 deg. Cent. at the highest load, owing to the large amount of surplus scavenging air. The M.E.P. could be kept high owing to the proper filling of the cylinder. At half load the exhaust temperature was 200 deg. Cent. The analysis of exhaust gases taken from three full-load samples showed them to be of consistent composition, viz.:—CO_2 — 4.75 per cent.; O_2 — 14.40 per cent.; CO — 0.10 per cent.; N — 80.75 per cent. At maximum load the gases emanating from the exhaust pipe could be faintly seen, but at normal full load and at light loads the exhaust was practically invisible. The blast pressure varied from 40–50 atmospheres (570–710 lb. per square inch) at half load, or a M.E.P. of 2.7 kilos. per square centimetre (38.5 lb. per square in.) to about 57–60 kilos. per square centimetre (800–850 lb. per square inch) at full load. The normal compression pressure is 30 kilos. per square centimetre (426 lb. per square inch). During the fuel injection and combustion period the pressure increased to between 35 and 37 kilos. per square centimetre (514–525 lb. per square inch). On account of the large quantity of cooling water, its rise in temperature was very small, only about 10 deg. Cent. at half load and at full load the temperature rose from 14 deg. to 30 deg. Cent., a rise of 16 deg.

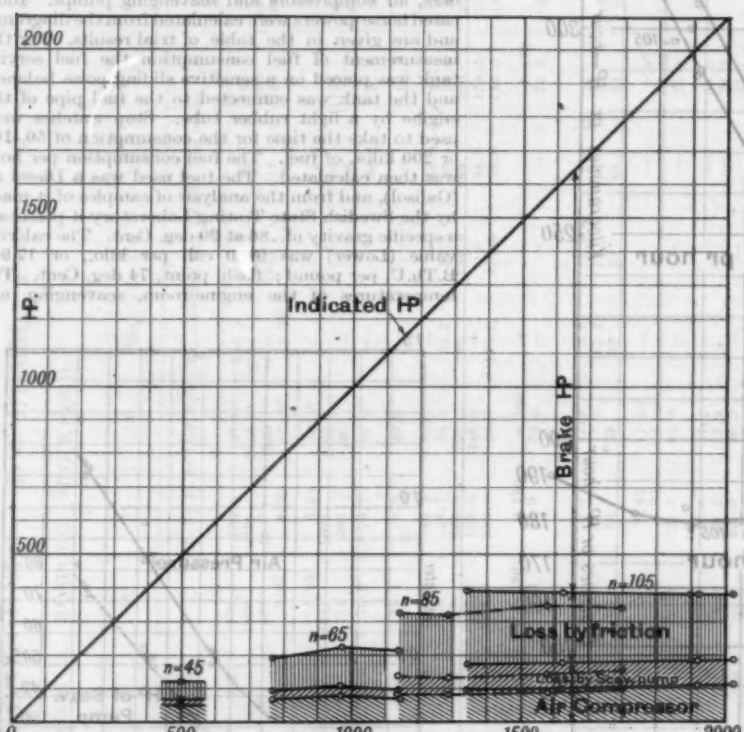


FIG. 5—MECHANICAL EFFICIENCY DIAGRAM

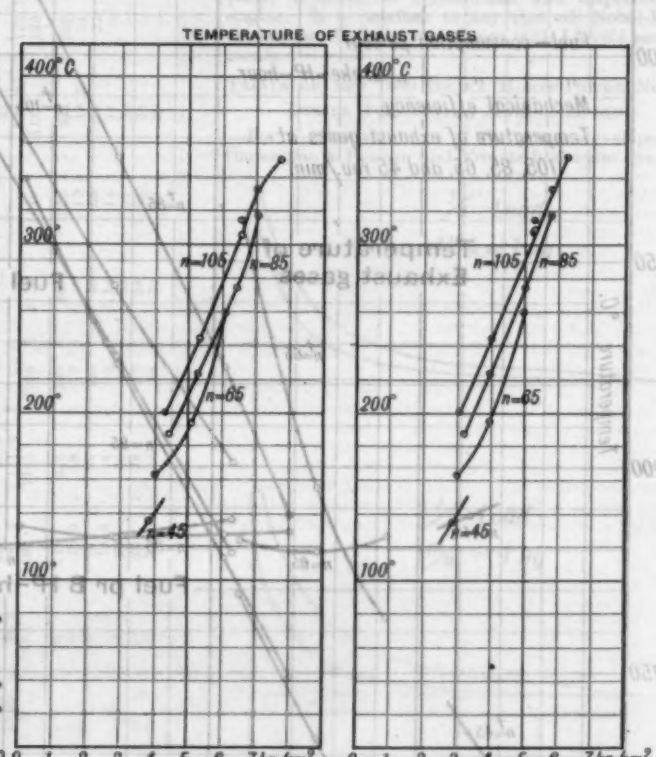


FIG. 6—EXHAUST TEMPERATURES AND EFFECTIVE PRESSURES

Organisation of Production.

"ORGANISATION of Production" was the title of a paper read before the Manchester Association of Engineers, on January 27th last, by Mr. J. W. Curtis, A.M.I. Mech. E. The author is an enthusiast regarding the use of graphic charts in connection with production organisation, so that the management can ascertain the state of the business at any time and foresee with a fair degree of accuracy what is likely to happen in the near future. The author said that by the aid of a production department the general manager of a works, while deputing detailed management to others, has a means of "keeping in touch" with and knowing the details of the position of any contract while keeping his mind free for the larger issues. From the records kept by the production department it is possible for the general manager to know the progress of the work as a whole and the relationship between all departments. In this way causes of delay can be investigated, and the general manager can deal with difficulties too great for his subordinates to tackle. The system of production organisation advocated and described in the paper is one which has been devised and developed to meet the requirements of a medium sized works whose business it is to supply and erect more or less complete installations of coal carbonisation plant for gas undertakings. The main contracts cover a great variety of work, including foundations, buildings, brickwork, steel structural work, elevating and conveying machinery, driving gear, gas, tar, water and electricity supply and fittings. There are also generally many minor contracts for re-building existing installations on up-to-date lines, as well as detail orders for spare parts.

The organisation suggested for such a works comprises the following departments with their respective functions:—

(1) *Designs and Estimating Department.*—(*a*) Should be in an office separate from the general drawing-office, but having access thereto. (*b*) Should prepare all schemes and designs. (*c*) Should revise all standard designs periodically. (*d*) Should prepare all estimates and costs up to the labour figure. For this purpose up-to-date working costs should be available from the accountant's department.

(2) *General Drawing-office.*—(*a*) Should prepare all detail drawings, material and general quantities, including the necessary information for the erection of the plant. (*b*) Should prepare requisitions for materials to the production department, which will arrange for purchase and delivery in accordance with the programme ahead. (*c*) Should be responsible for all alterations and extensions to plant, blocks and dies, design and lay-out of jigs and tools. The section of the drawing-office responsible for this may or may not be part of the workshop administration.

(3) *Production Department.*—It is the business of this department to know every single item which constitutes the finished product, and every operation involved in the manufacture of the various items made. It must have the necessary knowledge and acquaintance with the production problem to enable itself to keep deliveries balanced in relation to time and method of manufacture and erection. (*a*) This department should plan ahead all work in hand on all orders. In order that this may be efficiently carried out, it is necessary for the production department to be thoroughly conversant with the firm's policy. Immediately a contract is secured the production department should prepare a programme of requirements based on the tender, drawings and specification, with dates to suit the final date of completion which has been agreed upon. This programme should co-ordinate the work involved in the drawing-office, works and on the site for erection, and from it separate programmes should be drawn up for distribution to each department concerned. (*b*) Should carefully ascertain and keep constantly in touch with the capacity of the works and plant and changing conditions as they arise. (*c*) Should see that the firm's own plant is used as far as possible on work which cannot be conveniently sublet to specialists at a cheaper rate. (*d*) Should keep accurate records of progress on key items and compare these with the programme ahead, for the purpose of acquainting the management of the true state of affairs from time to time. (*e*) Should report to the management on the advisability of sub-letting work to outside sources of supply and should advise when necessary with plenty of notice, the introduction of overtime or night shifts in any department, in order to maintain continuity of supplies to contracts or for the purpose of balancing work due to troubles of any kind in any department. (*f*) Should forecast the possibility of completing contracts in the agreed times, and should point out, as near as possible, any necessity for accelerating or retarding any individual contract. (*g*) Should know the state of the stock, and have the power to take from stock to suit the requirements of contracts in progress. (*h*) Should purchase all materials (raw and finished) for contracts, whether for fabrication in the firm's own works or for delivery direct to the site from outside sources. (The purchase of all materials such as tools, works supplies, &c., for use within the works should be under the control of the works' manager.) (*i*) Should arrange for deliveries to agree with the requirements of the programme ahead. (*j*) Production from all departments should be governed by the principle of "programme ahead." Every year should have its "general arrangement" programme laid out, having due regard (1) to the relation of the expected output, (2) to the capacity of the works plant.

The author stated that it was a mistake to assume that production control could only be applied to mass production or speciality work. It had been shown in his paper that production control could be successfully applied after careful development in a works in which the articles manufactured were numerous and varied and the work further complicated by erection on site.

THE International Fair for the sale of books and for the exhibition of machinery and appliances used in the printing trade will be opened at Florence, during the last week of April, and will remain open until July.

Railway Matters.

THE *Ceylon Observer* learns that a suggestion has been made to the Government for the electrification of the railway on the Kadugannawa incline, when the hydro-electric scheme is put into operation. The length of the incline is nearly 12 miles.

THE South-Eastern and Chatham Railway bridge over the Medway at Rochester, which has been closed for two years owing to damage by fire, has been reopened. It has been reconstructed by the Cleveland Bridge and Engineering Company, Limited, of Darlington, and is to be known as the Cleveland bridge.

THE railway statistics for October last are not of the customary value, as the comparative month of October, 1920, saw a miners' strike from the 16th to the end of the month. Despite this, there were in October, 1921, 10.5 per cent. fewer passenger journeys than in 1920. Passenger train mileage increased 9 per cent.

THERE is nothing in Part IV. of the Railways Act, which deals with wages and conditions of service, to make any award of the National Wages Board binding. In view of this fact the meeting yesterday (Thursday) of the executive of the National Union of Railwaymen to consider the Scottish award is of interest.

THE first dividends to be announced by the principal companies are those of the Lancashire and Yorkshire, which pays 4½ per cent. for the year, the same as for 1920, and the Great Northern, which pays 2½ per cent. as against 2¾ per cent. The latter is a reduction, but not as great as was expected in view of the fact that no interim dividend was declared.

THE railway companies have resumed the issue of the weekly traffic returns, which, of course, contain no comparative figures, as for the first seven months of last year the railways were controlled. The first returns issued show that there is no uniformity as to the day on which the week ends; some have Sunday, others Saturday, whilst the Irish companies have Friday.

IN some observations on the change of name from "Lancashire and Yorkshire" to "London and North-Western" in the miscellany column of the *Manchester Guardian* of January 16th, it is said that over the booking-office at London-road Station, Manchester, may still be seen the coat of arms and title of the "Manchester and Birmingham Railway, 1839," and that over the clock at Oldham-road goods station there is plainly discernible "Manchester and Leeds Railway."

FORMER officers of the late Lancashire and Yorkshire Railway will be interested in noting that the two authors, Sir Henry Fowler and Mr. H. N. Gresley, of the paper on "Continuous Brakes for Freight Trains," read and discussed at the Institution of Civil Engineers last month, were both at one time connected with that system, that the President, Mr. W. B. Worthington, was its chief engineer, the first speaker, Sir John Aspinall, was its chief mechanical engineer and then general manager, whilst another speaker, Mr. R. E. L. Maunsell, had also been connected with the company.

ADDRESSING a recent meeting of the Surveyors' Institution, Mr. W. R. Davidge pointed to the need for increased speed on the London tube railways, which had so many stops that the average overall speed could not be much more than 18 miles an hour. The heavy cost of these railways, averaging £600,000 a mile, was almost entirely due to the cost of the stations, which were responsible for three-fourths of the outlay. If the stations, said Mr. Davidge, were kept five miles apart, a railway of double length could be constructed at half the price and provide rapid transit to the outskirts.

IN response to representations made by the Royal Agricultural Society of England and others, all the principal railway companies in Great Britain have agreed to reinstate during the coming season the arrangements which were in operation prior to 1917 with regard to unsold articles carried by railway and transferred from one agricultural show to another or exhibited at several consecutive shows and returned to the original sending station without being sold. This means that on production of the necessary certificates such goods will be charged at half the ordinary conveyance rates.

SPEAKING at Sheffield on the 28th of January, Mr. Arthur Neal, Parliamentary Secretary to the Ministry of Transport, said that he was hopeful that within a short time, by friendly negotiations now passing between the Ministry of Transport and some of the powerful railway companies in the South of England, a scheme of electrification would be started which would provide work for a number of the unemployed. He had at their request appointed a chairman, Sir Philip Nash, to preside over a small committee which was inquiring into the question. "The formalities may take some time," added Mr. Neal, "but I have no hesitation in saying that some scheme will proceed."

WHEN the 4.35 p.m. express from Euston to Birmingham was about 1¼ miles south of Blisworth on the evening of the 27th ultimo, the right-hand step of the tender engine—No. 1725, "George the Fifth" class—became detached and fell on to the permanent way. Rebounding, it struck the side of the leading coach and smashed nearly all the glass, and was then thrown towards the up line. The 10 a.m. from Glasgow happened to be approaching—engine No. 5000, Coronation, also of the "George the Fifth" class—and it was struck, doing slight damage to the engine and considerable damage to the first coach. A passenger in the Birmingham train was killed. At Major Hall's inquiry on Wednesday the driver said he found two bolts loose on taking over the engine at Bushbury on the morning of the accident, and another bolt loose when at Euston. Captain Beames, the divisional mechanical engineer, Crewe, said the tender came into Crewe works for general repairs in October. Among other repairs the steps were taken down and refitted and new bolts provided. Reports were put in as to this particular step having been reported on three or four occasions as loose, but all who could speak on the subject said that loose steps were most unusual.

Notes and Memoranda.

IN discussing the maintenance of the linings of electric steel furnaces before the West of Scotland Iron and Steel Institute, Mr. H. Etchells said that the wear on the lining was dependent a good deal on the working and manipulation of the slag. If one got a thin fluid slag which had a high reflecting power, it reflected the heat of the arc on to the side walls; but he had found that by working at as low a voltage as possible, and getting a very frothy slag—not one which was simply fluid but frothy all the time—the arc was very well buried, and the walls suffered very little wear.

THE latest report issued by the Swedish Ironworks Association shows that exports of iron from Sweden during 1921 were greatly reduced. Activity at the ironworks and mines was also largely curtailed, only twenty-two out of 133 blast-furnaces being in operation. The production of pig iron during the year amounted to 308,000 tons, or 42 per cent. of the 1913 production, while that of iron blooms and ingots amounted to 230,900 tons, or 31 per cent. of the 1913 production. Exports totalled 147,000 tons, compared with 502,000 tons in 1913. Exports of iron ore showed an increase, 4,333,000 tons being consigned abroad, compared with 3,737,000 tons in 1920. Imports of iron during the year totalled 128,000 tons.

THE January issue of the *Radio Review* contains some notes on the high-power radio station at Qwaki, near Tokyo, which was opened in March, 1921. The transmitting and receiving houses are about 20 miles apart, and the former contains arc and high-frequency alternator apparatus of 400 kilowatts capacity. The aerial, which is of the umbrella type, is supported by one main tower 656ft. high, which is a self-supporting reinforced concrete structure weighing about 11,000 tons. This tower is surrounded by eighteen masts 197ft. high, which are arranged n a circle round the central tower. The station is employed for duplex transmission, with the Hawaiian stations of the Radio Corporation of America, but it is intended to utilise it later for direct European traffic.

A YOUNG Scottish chemist, Mr. T. G. Ironside, has invented a process of low-temperature distillation of oil from shale, in which the powdered shale is pre-heated until it is just about to begin giving off vapours. It is then mixed, according to a description in the *Iron and Coal Trades Review*, in a retort with hot sand introduced at another part of the retort. By these means the shale is raised to the temperature necessary for complete carbonisation under low-temperature conditions, while the sand is just a shade hotter, and there is still sufficient heat present to distil off the volatiles. So far the process has been tested with a makeshift retort in South Africa, using the Waaihoek Cannel coal. No sign of clinkering of the material was observed in these tests.

OWING to its exceptional qualities, zirconia is particularly suitable for the internal linings of metallurgical and electric furnaces, and for this purpose the natural zirconia ore is frequently quite suitable. Meyer states that a zirconia lining used in a Martin furnace in a German steel works was still in very good condition after four months' service and could have been used for at least another four months without being changed. This meant that a saving of over 50 per cent. on upkeep expenses over ordinary refractory material was being effected. Instead of using zirconia earth directly, refractory bricks can be made. Their sale price is rather high, and to lower it the idea has been recently advanced of manufacturing the bricks of more common materials, such as bauxite, clay, or silica, and then coating them with pure zirconia. The bricks thus obtained are very resistant to the attack of slags.

AMONG the recommendations of the Committee appointed by the Ministry of Health to report on smoke abatement, there are the following suggestions:—That the Central Housing Authority should decline to sanction any housing scheme submitted by a local authority or public utility society unless specific provision is made in the plans for the adoption of smokeless methods for supplying the required heat as suggested in the Committee's Interim Report. The only exception to this rule should be when the Central Authority is fully satisfied that the adoption of such methods is impracticable. That gas and electricity undertakers should be given every facility and encouragement to increase and cheapen the supply of gas and electricity, and that the practice at present followed by some municipal authorities of over-charging for gas and electricity in order to allocate the profits thus accruing to the relief of the rates should be discontinued.

MUCH interest has been aroused in Ceylon, according to *Indian Engineering*, by the announcement that Messrs. Wolfe, Barry, Lyster and Partners, in their recommendations to the Madras Government, favour the selection of Tuticorin for extension as a deep-water port. It is estimated that the work, which will take about five years to complete, will cost, approximately, Rs. 152 lakhs, and it is stated that the engineers have not overlooked the effects which may follow upon the opening of the Indo-Ceylon railway route and the competition which may arise from Colombo. It is pointed out that Tuticorin is hardly likely to provide such facilities for the oil bunkering of vessels as will be shortly possessed by Colombo, that Tuticorin cannot hope seriously to compete with Colombo as a port of call, that owners will be very loath to permit their vessels to call both at Colombo and Tuticorin if it can be avoided, because of the delay involved and the additional dues which will be incurred. In this latter connection, however, everything will depend upon the cost of transmitting South Indian goods landed at Colombo by the rail route. At present no facilities exist at Colombo for landing cargo direct from vessel to dockside, and double handling at Talaimannar and Danushkodi is necessary. A wet dock will solve the first problem, and an Indo-Ceylon bridge will partly solve the latter. However, since Ceylon possesses a broad gauge railway and South India a metre gauge one, handling of goods will still be imperative. The main point for consideration now is whether, instead of developing Tuticorin, it would not be better to make Colombo the port and proceed with the temporarily abandoned project of constructing a railway bridge between India and Ceylon by way of Adam's Bridge.

Miscellanea.

A LARGE body of high-grade copper ore has been discovered on the Monarch group at Beasley, Nelson, British Columbia.

AN estimate of Rs. 3,00,000 for the purchase of eight electric conservancy lorries has been approved by the Corporation of Calcutta.

THE discovery of a radium mine in Brazil has been reported by Mrs. Alexander Grosse, who has just returned from an expedition into the interior. At the base of the mountains is a medicinal lake used by the natives. This lake is radio-active.

THE Chinese Government has authorised the Netherland Syndicate, Limited, to place orders in Holland for the construction of 150 railway bridges of various spans. These bridges are for the eastern part of the Lunghai Railway, which is now being built under the direction of three Dutch engineers.

THE German trade returns for 1921 show that during the year imports into the country amounted in value to 13,700,000,000 marks and exports during the same period to 14,000,000,000 marks. This is the first time since the war that there has been an excess of exports over imports, which is apparently due to restrictions on the import of food.

THE Chinese and Japanese delegates at Washington are said to have reached an agreement whereby the coal and iron mines of the Kiachow leasehold shall be operated by a company formed under special charter by the Chinese Government. Japanese will be permitted to invest capital in the enterprise to an amount not exceeding the amount of the Chinese capital.

FRENCH authorities have decided that farmers throughout the country are to be advised every day by wireless of the Paris Observatory's weather forecast at the time it is made instead of waiting for the morning newspapers. Instructions on the erection of a wireless receiver are to be sent to all interested, and they will not be subject to any State tax for enjoying this privilege.

AT the annual dinner of the Geological Institute of India, which was held at Calcutta on January 27th, the Governor of Bengal referred to the indigenous iron and steel enterprises as a fair index of industrial development. Labour disturbances, he added, coupled with political unrest, might have a disastrous effect on industrial development by demoralising labour and frightening capital.

THE first prize in the Transatlantic amateur wireless tests has been won by the Manchester Wireless Society. The receiving set used in the test was erected at the residence of Mr. W. R. Burns, who was responsible for the manipulation of the various instruments lent to him by members of the society. These instruments, together with the special panel built for the occasion by Mr. Burns himself, enabled the tests to be carried through successfully.

IT is reported from Capetown that the Marconi Company has offered to equip South Africa with an efficient long-range wireless service within eighteen months, and to run the station when completed. The company undertakes that its expenditure on the proposed station shall not be less than £400,000 exclusive of duty and sites. Alternatively the company offers to build and conduct stations on joint account with the South African Government.

ACCORDING to Canadian statistics, the value of silver produced up to the end of 1921 from Cobalt and the surrounding districts will reach an aggregate of close to 200 million dollars. Total dividends from the silver mines will exceed 93 million dollars, and, with the treasuries containing surpluses which, combined with disbursements actually made, show a net profit of over 50 per cent. of the gross yield, this is regarded as a result without parallel in the history of any other mining area.

BORING in the coal area at Morwell, Victoria, has so far been carried out only on the western side of the Moe-Morwell Railway. Arrangements have, however, now been made with the Mines Department to explore the ground on the eastern side of the line to ascertain whether the deposits of brown coal continue in this area, and to determine their nature and extent. Attention is being devoted to the utilisation of pulverised brown coal as fuel, and plans have been prepared for the installation of an experimental plant for the production of brown coal in a powdered form.

SPEAKING at Liverpool recently on the telephone system of the country, Sir William Noble, engineer-in-chief to the Post Office, vigorously defended it from the criticisms which have been launched against it. He denied that under private control things would have been better, and contrasted it favourably with the system in America. Premising that the telephone system should not be subsidised at the national expense, but should pay its own way, he asserted that the present scale of charges was justified, but assured his hearers that any possible opportunity of reduction would be taken advantage of.

SALVAGE operations at Oppau are being expeditiously forwarded, says the *Chemical Trade Journal*, cranes provided by Krupps being employed. The larger part of the 7000 tons of ammonium sulpho-nitrate left intact by the explosion has been removed without accident, owing to the careful precautions that were taken. The reconstruction of the comparatively undamaged part of the works is far enough advanced to permit resumption of production, especially of ammonia. Nitro-sulphate is no longer being manufactured at Oppau. The commission instituted by the Reichstag to investigate the causes of the explosion has just published its report. Two important facts are emphasised:—(1) The sulpho-nitrate of ammonia can explode if it contains more than 50 per cent. of ammonium nitrate, and its detonating properties increase as the amount of nitrate contained rises above this figure; (2) it has been established that in the silos at Oppau which exploded, segregation of ammonium nitrate had occurred with the result that in several places in the mass the ammonium nitrate content of the mixed fertiliser reached 90 per cent.

OVERHAULING DEPOT OF THE LONDON GENERAL OMNIBUS CO.

(For description see page 121.)

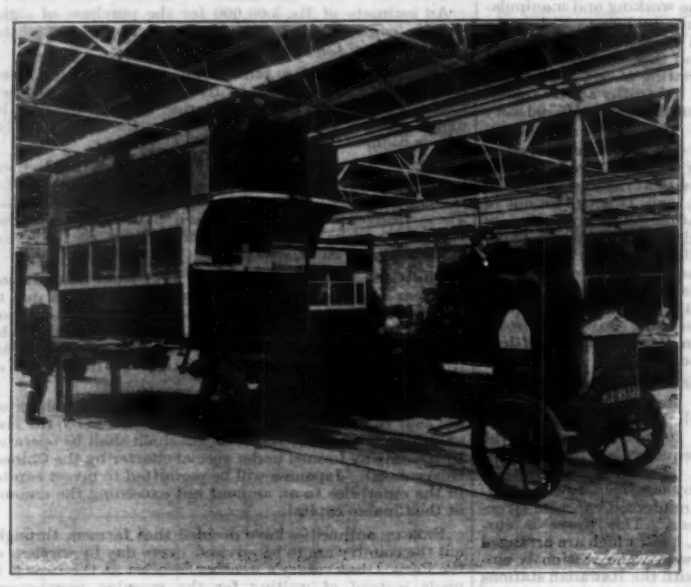


FIG. 8—HYDRAULIC LIFT GEAR FOR BODIES

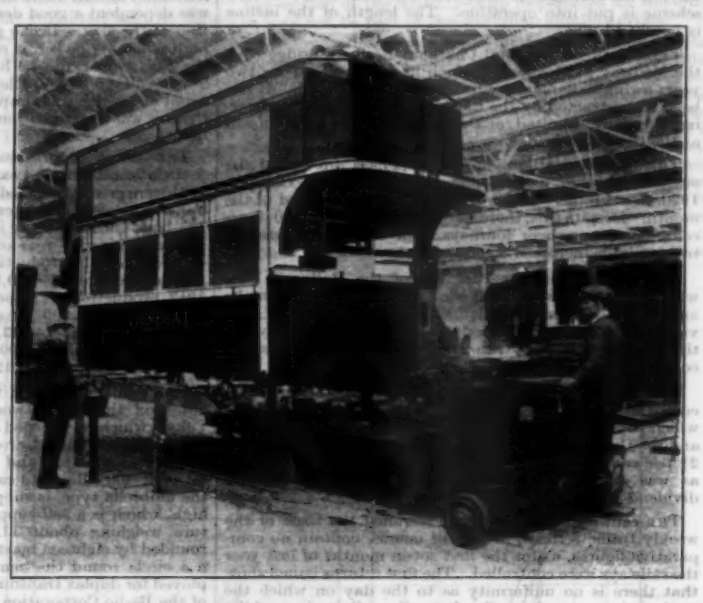


FIG. 9—BODY LIFT AND ELECTRIC TRUCK

FIG. 10—UPHOLSTERERS' SHOP

FIG. 11—SAW MILL

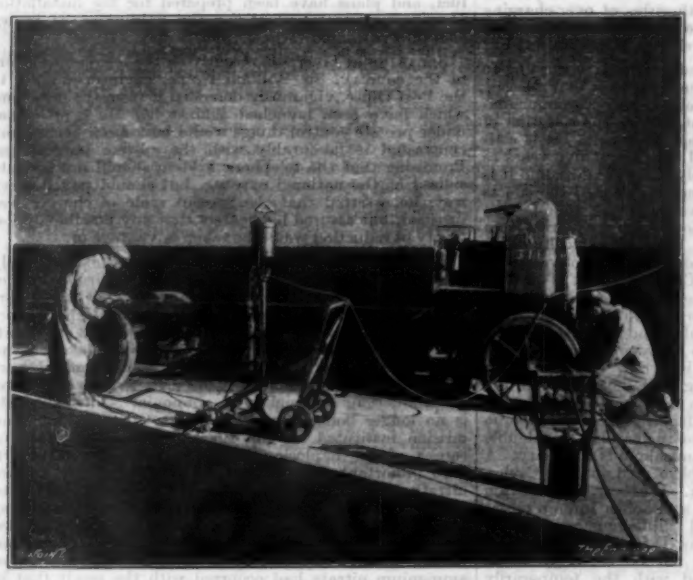


FIG. 12—PAINT SPRAYING OF CHASSIS

FIG. 13—MATERIALS CONVEYOR

THREE-CYLINDER EIGHT-COUPLED

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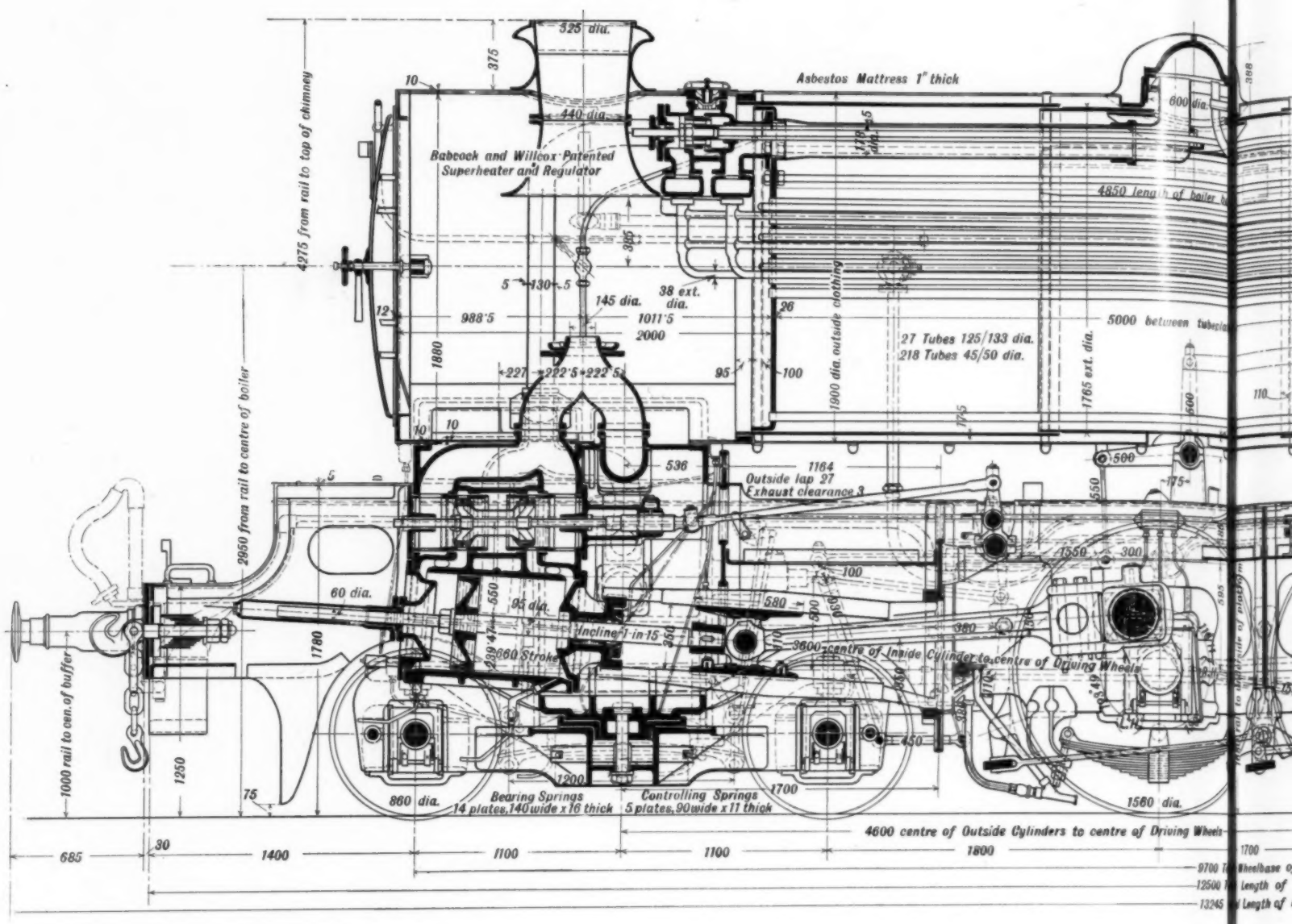

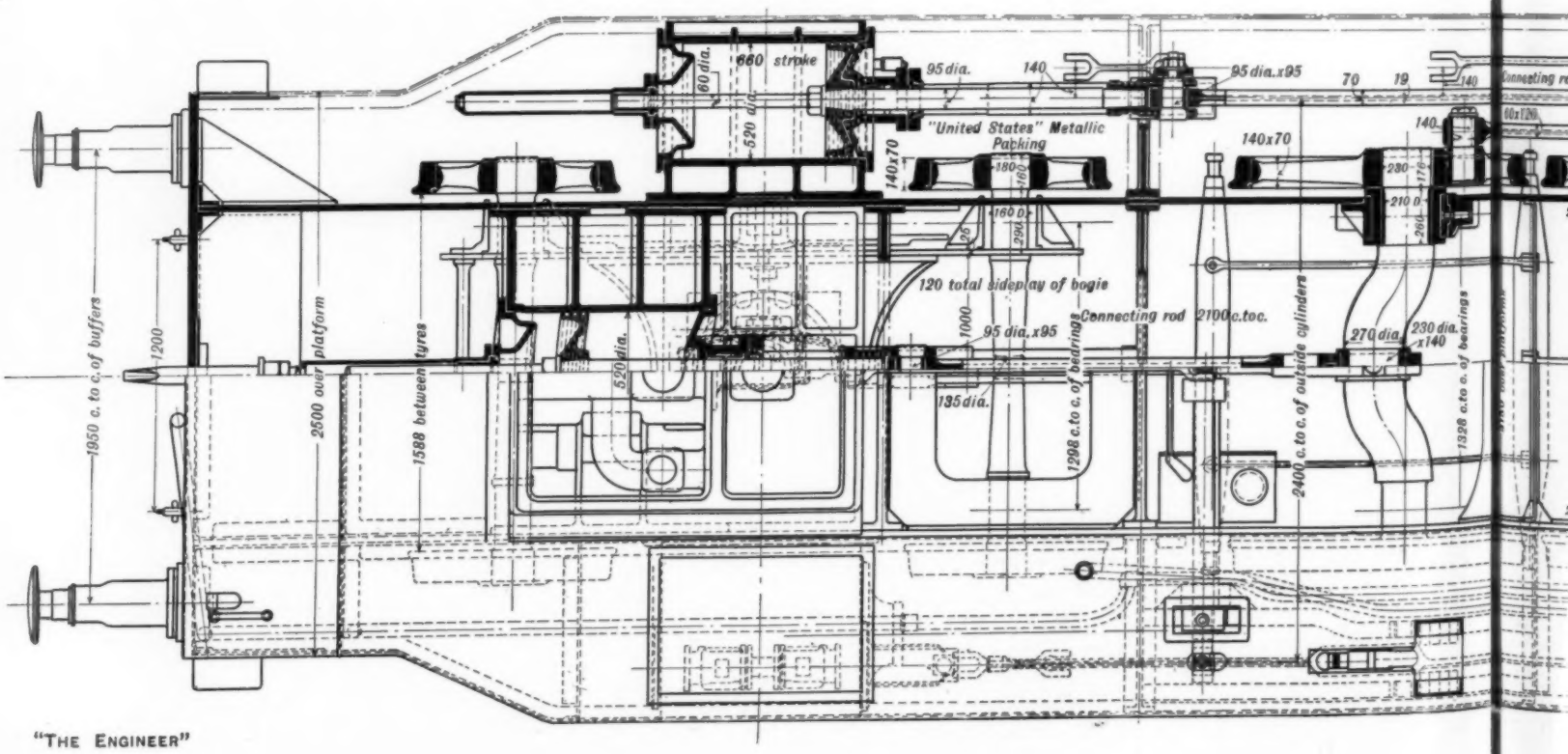

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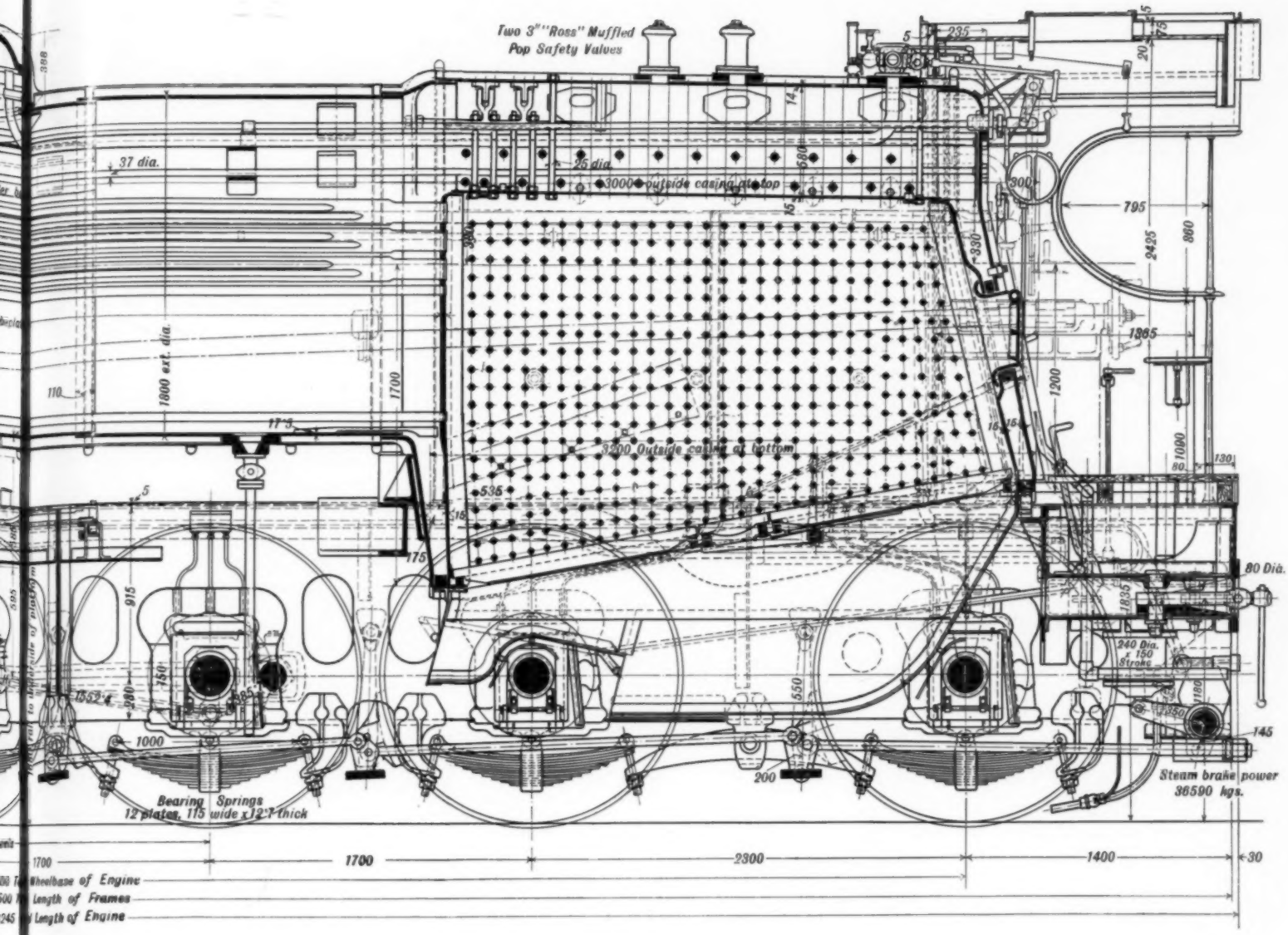

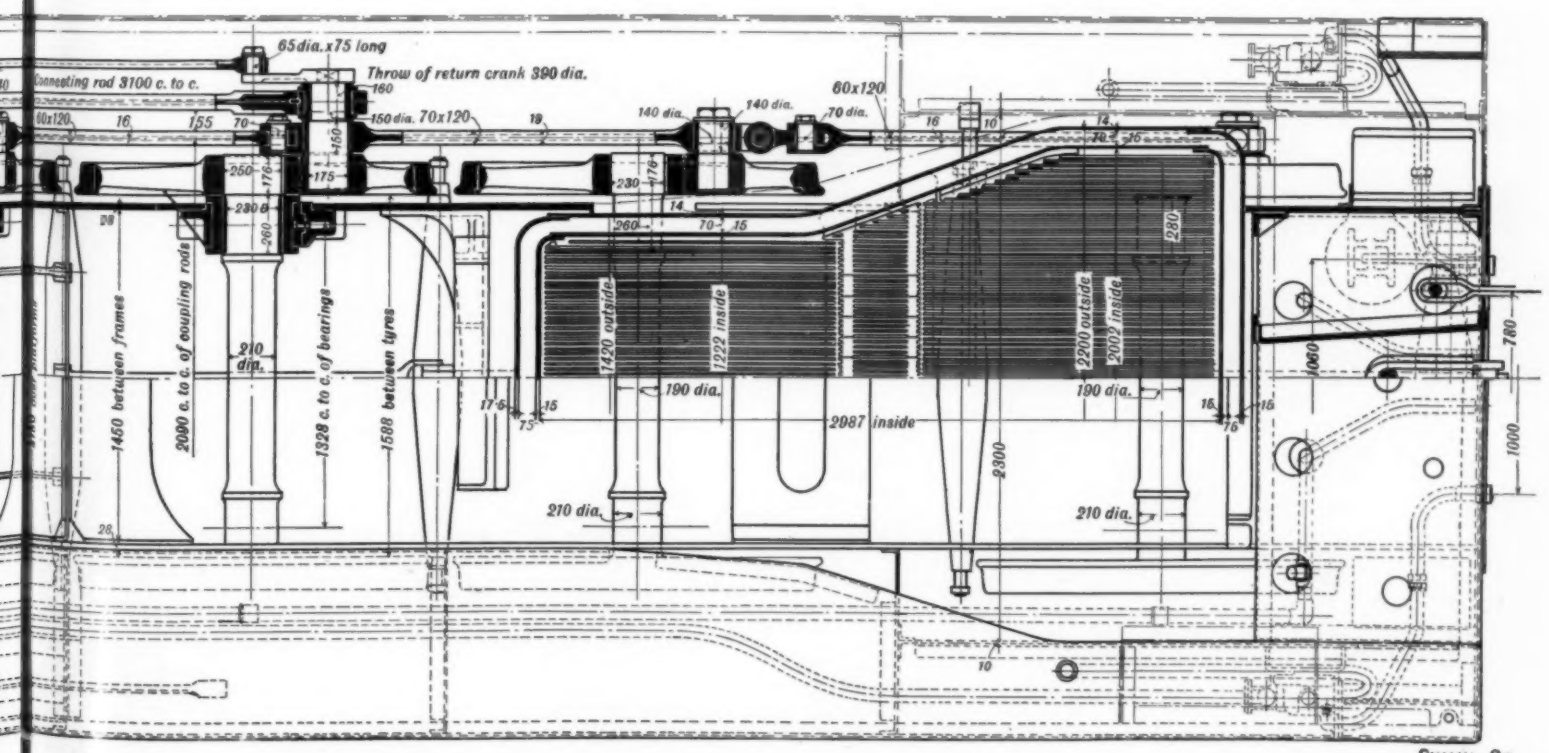

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TWO-PAGE SUPPLEMENT—THREE-CYLINDER EIGHT-COUPLED LOCOMOTIVE FOR SPAIN.

THE ENGINEER.

FEBRUARY 3, 1922.

American and European Engineers.

IT would never do to take after-luncheon speeches at a club too seriously. On such social occasions speakers may surely be allowed a little latitude, and if they should be carried now and then into the paths of hyperbole—the pavéd way of public speaking—no one should subject their words to rigid analysis; neither cavilling at those things with which they do not agree, nor stressing, for their own ends, those in which they concur. Hence, when we read in a recent number of the *Journal* of the Engineers' Club of Philadelphia a speech by Mr. Axel Malm, in which the business methods of European engineers are favourably contrasted with those of American engineers, we take care neither to believe, *au pied de la lettre*, all that Mr. Malm said about his compatriots-by-adoption nor to magnify the praise he bestowed upon European engineers. Rather, indeed, do we take the opposite course and, recognising how justly many of Mr. Malm's criticisms may be applied to ourselves, seek to find in his advice to American engineers admonition that may benefit us.

Put briefly, Mr. Malm charged Americans with what we may call "continentality." Now continentality is the macrocosmic form of insularity, that vice with which every reformer who fails to break down her traditions and methods charges Great Britain. "We have," said Mr. Malm, "the largest country in the world, with the most wonderful resources. There is no question about that at all. We have manufacturing methods that are far superior to anything used in Europe, but we are so 'dog-gone' large that we think we know it all—and we are trying to capture the entire world by our American business methods, and it can't be done." Within this great "continentality" there is a lesser continentality, and to it Mr. Malm traced the root of the trouble. In America, according to him, the engineering student allies himself as quickly as he can with some mighty concern, "like the General Electric or Westinghouse or Ford Motor Company; he never seems to think that the little fellows are, in many cases accomplishing much more than the big firms, because the big firms have an established policy." The young man stays with that firm and becomes saturated with its methods and its products. But some day he himself becomes a buyer, and he places his orders with the firm whose child he is. "Nobody else can sell him anything, because that is all he knows. Because he learns from the General Electric Company, or any other company, the American business methods—and he stays at home and doesn't learn any other—he feels that this country is so immensely large and he is such a big engineer that he doesn't have to learn from anybody else; but after two months abroad he won't know there is an America as far as the building of machines is concerned." Another quotation will show the contrast with European firms of which, Mr. Malm asserted, seventy per cent. had had their representatives in America for the past three years, visiting every big plant and staying at each two or three months. "Don't you think, while it is an advantage to be so very big, it has its drawbacks? I think it has. I think we have made such a success in business, through our manufacturing methods in specialising and through our advertising, that we have the feeling that wherever we go we are bound to succeed. The European knows that. He knows our weak points to-day, and the European engineer comes here to study a particular design—to find out our weak points, and then to go home and try to use our good points—and not to tell us a thing about it."

It will be recognised, we think, that Mr. Malm has been too generous to European engineers and probably a little too severe on Americans. We fear that even if we allow for much greater activity in other European countries than in Great Britain, it would be hard to justify the statement that seventy per cent. of them have active representatives seeking knowledge in America and bringing it home. But at least this is true, that American engineering is more closely studied in this country than British engineering is studied in America. One has only to contrast the technical Press of the two countries to see that statement confirmed. Furthermore, specialisation has not yet gone quite so far here as in the United States, and we still have a fair measure of that flexibility of supply which Mr. Malm told the Americans they must seek. But with all this we fear the principal counts in the indictment would lie as much against our own people as against our cousins. Our huge Empire gives our young men great opportunities of which more advantage might be taken. There was a time when no gentleman's education was complete till he had made the *grand tour*. Were it only possible for every young engineer to devote one year to the acquisition of foreign experience the benefit to the country would be great. It could be done, as a rule, without great cost, for there is always some money to be earned by the sincere worker, and if hardships had to be borne, why, youth is none the worse for them. There is, we are glad to know, a movement towards the exchange of apprentices between the nations. It can do nought but good, and we hope to see it encouraged by employers, by colleges, and by technical institutions.

Automatic Train Control.

DURING the nine years 1909–1917 inclusive 13,339 collisions occurred on the railways of the United States. Through them 2454 persons were killed, 37,724 were injured, and damage to railway property alone of over nineteen million dollars was suffered. During the two and a-half years which ended on June 30th, 1920, 3226 collisions occurred, causing the death of 635 persons, injury to 6240, and material damage of over seven million dollars in value. These facts have led the Inter-State Commerce Commission to take action under a section of the Transportation Act of February, 1920, which provides that the Commission may, after investigation, order any railway company to install automatic train stop, train control, or other safety devices. Notice has now been served on forty-nine principal companies ordering them to show cause by March 15th why they should not install by July 1st, 1924, between designated points in their main lines, automatic train stop or train control devices complying with specifications and requirements set forth in the order. Complete and detailed plans of what the companies propose to do are to be submitted to the Commission, and by July 1st next full particulars of the system or systems in use and of the number and type of the locomotives designated to or engaged on the fitted section are to be furnished, and the companies are to "proceed diligently and without unnecessary delay to select and install the devices as specified." The installation must provide for either or both of the following:—(1) Automatic train stop, *i.e.*, the application of the brakes until the train has been brought to a stop; (2) automatic speed control, *i.e.*, the application of the brakes when the speed of the train exceeds a prescribed rate, and its continuance until the speed has been reduced to a predetermined and prescribed rate.

In view of the fact that for fifteen months a Departmental Committee, appointed by the Ministry of Transport, has been considering the

question of the use of automatic train control on British railways, this action of the American authorities is instructive. A history of the events that led up to the issue of the order is, however, of greater interest. In June, 1906, Congress passed a resolution authorising the Inter-State Commerce Commission to make inquiry as to the use of and necessity for the block system and apparatus for the automatic control of trains. It may be observed in passing that the necessity for the block system was, in those days, more apparent than was the need for the automatic control of trains. A Block Signal and Train Control Board was appointed in July, 1907, and remained in existence until June, 1912. During those five years 1146 devices and systems intended to promote the safety of railway operations were submitted to it. Its labours came, however, practically to nought. The explanation is possibly to be found in the following sentence from the Board's fourth annual report:—"But when all is said that can be said in favour of the use of automatic safety devices, it still remains true that they correct none of the fundamental defects in American railway practice. Bad methods of operation and management, inefficient supervision and inspections, poor discipline, and lack of co-operation between the different branches of the *personnel*, deficient structures, roadway and equipment, all of which introduce fundamentally dangerous conditions, still exist and cannot be remedied by the use of automatic appliances." It is of interest also to note that as a result of several serious collisions in and immediately prior to the year 1912, the New York, New Haven and Hartford Railroad Company offered a reward of ten thousand dollars for a perfect system of automatic train control. Well over fifteen hundred ideas were submitted, but only five per cent. of them were thought worthy of consideration. Since 1912 this question has constantly been brought under notice in the accident reports of the Bureau of Safety of the Commission. But despite the bad accident record we have quoted, the frequent recommendations of the Commission and the appeals for ideas to be submitted, it remains the fact that the only steam-operated railway lines trying automatic train control are the Chicago and Eastern Illinois, the Chesapeake and Ohio, and the Chicago, Rock Island and Pacific. It is important to note that the Commission says to the forty-nine railway companies, "the automatic control of trains is practicable." As its use is now made compulsory, there being no appeal against the order, future developments will be awaited with interest.

But whilst automatic train control may be considered practicable in the United States, it by no means follows that it is so in Great Britain. The climatic conditions there may be worse than here; but, on the other hand, all American trains, passenger and goods, have continuous brakes, practically all the rolling stock is company owned, there is little foreign running, i.e., one company running over the tracks of another, and not only is there, proportionately, less signalling, but what there is is without the complications to be found here. The difficulties to be met with before automatic train control could be used here were reviewed in a leading article which appeared in THE ENGINEER of October 8th, 1920, when the appointment of a committee to consider this question in its relation to British railways was contemplated. We have not the least idea when this committee, over which Colonel Pringle is presiding, will report, nor in what terms. Train control is, of course, possible and may be practicable. But it does not follow that it is expedient. In the article just named we said we found on looking through our file of accident reports that during the ten years 1910–1919 reports were made on fifty-five collisions which had been caused by drivers passing signals at "danger." Since then, and up to and including the report, issued last week, on the collision of November 26th last at Birmingham (New-street), ten more such accidents have occurred, making sixty-five in twelve years, or an average of less than six a year. Such results hardly warrant the *compulsory* adoption of automatic train control. Moreover, automatic control will not prevent all such collisions. Take, for example, that of September 26th last at Dawlish. The driver knew that the "distant" was against him and he had his train well in hand. Train control would have done no more. Yet he over-ran the home signal and came into collision with a goods train. Or take the Birmingham accident just mentioned. It occurred inside a busy station, and as all the signals at the entrance were at "clear," and as the driver entered the station with his train well in hand, we cannot see how train control would have prevented that collision. Obviously, there is no pressing reason for its adoption here, and seeing, then, that it is to be so thoroughly tested in the United States, it might not be bad policy to see what is done there before any definite steps are taken in this country.

Institution of Mechanical Engineers, North-Western Section.

THE North-Western Section of the Institution of Mechanical Engineers has been rather unfortunate this session in connection with its meetings. The attendance of members on Thursday, the 26th ult., to hear Messrs. Denny and Knibbs' paper entitled "Some Observations on a Producer Gas Power Plant," was the smallest we have yet seen in Manchester, in spite of the fact that engineers in this district are usually very keen on discussions of topics connected with the internal combustion engine. There were probably two reasons for the apparent lack of interest on this occasion, the principal of which was probably that the authors' names were unfamiliar, and the other that the meetings of engineering societies this session have been badly arranged through lack of prevision on the part of the organisers—a matter which must receive attention next session. Reference was recently made to this matter by our Manchester correspondent. Not only are there periodical meetings of the leading institutions, the Civils, Mechanicals, Electricals and the Juniors, there are also those of the Manchester Association of Engineers, the local Engineering Council, and debates organised by the Engineers' Club. Three or four of these functions in one week are evidently considered excessive. The last meeting was doubly unfortunate on account of the absence of both of the authors and the chairman of the section, but those members who did attend were rewarded by a very illuminating discussion.

The paper was very well read in abstract by Mr. Dempster Smith, and Mr. William Fox, the newly elected member of the local committee, presided.

The discussion was opened by Mr. R. Wollaston, who said that the paper was one of the most useful that had been read before the Institution for a number of years. The results were most valuable, especially those contained in some of the diagrams, inasmuch as they indicated what not to do. Mr. Wollaston mentioned the plant erected at Sheepbridge Colliery, which was simply intended to recover sulphate of ammonia from coal that in those days was practically unsaleable. The results obtained from this plant were infinitely better than those given in the paper. As a matter of fact, the latter results were the worst he had ever seen in connection with a Mond recovery plant. He understood that the authors were chemists rather than engineers, and were not in any way responsible for the running of the plant. Mr. Wollaston then went on to say that for a number of years he had been working on patents with the idea of eliminating many of the defects in the plant shown by the charts and subject matter in the paper. For example, the authors had made a great point of the bad results due to poor efficiency in the boilers. In his opinion, in a plant of this type, boilers were not necessary. There was enough heat radiated from the producer and in the outgoing gas to raise all the steam needed. He thought that in the Mond plant the immense amount of steam was added for purely physical, not chemical reasons, as only a small proportion of the steam became gasified, and that proportion was responsible for the high hydrogen which the authors suggested was obtainable in the gas. He hoped to be able to demonstrate within a short time that a recovery-gas giving better recovery results than those shown in the paper could be obtained with a gas of chemical composition very closely resembling ordinary non-recovery producer-gas.

With regard to the question of economy of gas in large stations, Mr. Wollaston thought that the days of the possibilities of the gas engine for large stations had gone by, unless there was something in sulphate of ammonia recovery. He stated that results were being obtained in steam stations of about 17,000 B.Th.U. per kilowatt—that was from the coal—which results he did not think could be beaten by any gas engine installation. Taking into account the fact that the gas power station must necessarily have heavier capital charges than the steam power station, unless there was something to be obtained from a by-product recovery, Mr. Wollaston did not see any hope for the gas power station in competition with the steam power station in the future.

Mr. Fielden pointed out that the results given in the paper were not those of merely a week's test taken when the plant was first installed, but of a commercial test, taken over a number of months, and on that account he thought that the figures were the most valuable ever published. As the authors had remarked in the paper, the mechanical arrangements were poor and the layout bad. He had noticed the statement that producers of 10ft. 6in. diameter were supposed to gasify one ton of coal per hour. He himself had had considerable experience of producers, but would never expect a producer of those dimensions to gasify one ton of coal per hour, and did not think that such a result could be achieved commercially. The authors also stated that 16 tons per day was the best average, but by forcing the producers sometimes 19 tons could be obtained. That meant that the quantity of ammonia recovered was low, and that the quality of the gas was poor. Mr. Fielden agreed with Mr. Wollaston with regard to poor efficiency, and thought that steam boilers ought to be cut out. He would also, he said, cut out the sulphate of ammonia recovery. He noticed that it was stated in one test that 913 tons of coal were actually gasified and 242 tons were wasted in the boilers. He was surprised that tests had not been made on a non-recovery plant, as it was a very simple matter to make them. The ammonia recovery part had to be left out, and the plant worked with the small amount of steam actually required for gasifying the coal. In that way, by taking 1 lb. of coal as 12,500 B.Th.U., only ¾ lb. water was needed. To evaporate this 1116 B.Th.U. would be required, and the heat of the gas from the plant would give all the steam necessary. Thus the plant could be worked without the boilers. Under present-day conditions, Mr. Fielden thought that the ammonia recovery plant would not pay at all, even when working twenty-four hours a day and seven days a week. During the war the price of sulphuric acid went up, so also did wages, and the cost of the plant, but the price of sulphate of ammonia did not go up in proportion. The figures of costs given in the paper were far below what the cost would be to-day. It was stated that the plant cost £60,000, whereas it ought not to have cost more than £45,000, but the engines, at such a low figure, were almost given to them, and were only about half the present price. Taking into account these high costs, 6 per cent. interest on capital, and 5 per cent. depreciation on the whole of the plant, including buildings, Mr. Fielden calculated that working twenty-four hours every day in the year, the cost would be £16 12s. per kilowatt hour, which was too high for practical purposes. He also took exception to the method of calculating the amount of gas by sulphuric acid solution. This was done by analysing a portion of the gas passing through a weak solution of sulphuric acid and calculating from that the amount of gas going through. This method presupposes ideal conditions of ammonia recovery. With regard to the statement that the temperature of the gas leaving the producer was 1054 deg. Fah., he remarked that it was well known that 900 deg. Fah. was a fairly good temperature for sulphate of ammonia recovery, and as concerns pre-ignition, somebody had suggested that hydro-carbons were the cause, but in his experience, hydrogen itself was the cause. A high hydrogen content with a high compression gas engine would cause pre-ignition, and means whereby the gas going to the engine was actually diluted had been adopted. He quite agreed however, with the results and conclusions arrived at by the authors.

Mr. Drummond Paton remarked that he was pleased to note the authors' attitude towards general national economics in mining. The writers had stated that the laboratory was highly organised, being comprised of chemical and engineering staff. Unfortunately, the speaker had not noticed a single reference to microstructures, which were very much more valuable with regard to physical behaviour in retorts and gas producers than either chemical returns or engineering accuracy in operation. He himself could supply the writers with six illustrations of coals which had virtually the same chemical analysis—according to the established chemical standard—but which under the microscope showed entirely different formation and grouping of the constituent of the coal. It was this phase of the physical structure of the coal which has to be carefully studied so as to establish correct operation in the producer—of course, combined with chemical analysis and engineering facilities. Again, the authors cited the coal as not of the best quality, and that the results would have been better if they had had a better coal. What did they actually want as a basis of operation, for if producers as operated by them—presumably fairly expertly—could not tackle this material, then how did they propose or how would they effect successful operation with low-grade materials? Those low-grade materials had already been successfully used by ordinary operators, and would have to be successfully utilised in the future, when the national mining systems would bring into the market a material which previously had been lost to the country. As research engineer to George Westinghouse and superintendent of the Gas Producer Division of the Westinghouse Machine Company, Pittsburgh, about fourteen years previously he had had to tackle the gasification of a coal somewhat similar to that referred to, but possibly more accentuated in its tar-producing qualities, the objective being a producer for Transatlantic service combined with the gas turbine. The method was to invert the supply of coal. Instead of feeding the coal from the top, the coal was forced in, under pressure, from the bottom of the producer charge. Under these conditions the saturated gases had to pass through an incandescent carbon zone, and in the gas obtained in the first stages of the cycle of operation tar was an unknown quantity. This was all right until the third day, when it was realised that, having inverted the feed they had also inverted the ash bed. By the fourth or fifth day of operation there was a clinker bed varying from 3in. to 6in. in the middle,

and 9in. to 15in. at the side of the producer, which eventually formed a tight canopy that it was impossible to remove. Various suggestions were made with a view to get free ash formation, and the removal of the ash by an annular return down the outside of the gasification chamber.

The question of hydrogen action in gases had been frequently referred to, and it was a matter on which extensive investigation was also made by his firm in connection with the linear velocity of ignition of gases in which hydrogen was present in varying quantities. The best idea of the behaviour of this gas could be obtained by a close investigation of Professor Dixon's (Manchester University) work on "Explosion in Tubes." It was generally assumed that gas was ignited from the point of ignition and that combustion progressed towards the end of the chamber. The fallacy of that assumption was quite apparent if one studied the ray projection and detonation curves, and the zones of initial incandescence by the crossing of these rays, and the writer suggested to Professor Dixon that the path of these rays, by virtue of explosions being a series of detonations, was defined by the selective affinity of certain particles, the periodicity of which provided initial detonation, and he further suggested that hydrogen in a gas of the suggested composition became primarily the passage medium for that ray projection and detonation effects in the development and completion of an explosion. Again, there seemed to be a finding that carbon was the desideratum of all producer work, and that the hydrogen and hydro-carbons seemed to have a field of their own. This, he said, was apparent to him fourteen years ago, and was again developed by him twelve years ago in a paper on "Small Coal or Dust: Its Production, Prevention and Utilisation." In that paper it was suggested to utilise the coal primarily for the extraction of its hydro-carbon content as oil and to pass forward the residual into the producer for the final gasification and ammonia recovery.

Dr. Morley stated that he was interested in the performance of the exhaust gas boilers in connection with gas engines. From the particulars given in the paper he had calculated the weight of exhaust gas per brake horse-power hour, and the rate of flow through the boiler tubes. Using the constants for heat transmission in flue tubes established by Lawford H. Fry, he found that the probable temperature of the gases at the exit from the boiler would be 430 deg. Fah. From the weight of gases, their specific heat and the fall of temperature in the boiler, the heat given up by them was then calculated and was found to be sufficient to evaporate 1.65 lb. of water from and at 212 deg. Fah. Even though no allowance was made for external heat losses, that figure was considerably below the evaporation figures in the paper. He did not think that uncertainties in the data for heat transmission were sufficient to account for the discrepancy, and suggested that the temperature of the exhaust gases leaving the engine might be higher than that recorded in the tests, or perhaps the ratio of air to gas supplied to the engine was underestimated by the authors. An increase in the air ratio would increase the heat given up in the boiler in a more than proportionate degree, since the increased amount of gas would mean an increased speed in the boiler tubes and a somewhat lower exit temperature. It would have been of interest had this exit temperature been measured, and it would have thrown light upon this point. It had to be borne in mind that in these boilers, unlike ordinary boilers with limited draught, the amount of gas passing through the tubes was fixed by the gas engine, and it could be forced at high speed without undue increase of back pressure at the engine, so that a high rate of heat transmission was quite feasible. He thought that the figures sometimes claimed for the evaporation in exhaust gas boilers required to be regarded critically, as they might indicate that the gases were leaving the engine with an excessive amount of heat in them, and that consequently the engine efficiency was less than it ought to be. That remark must not be taken, however, to apply to the case described in the paper, but to statements which had been published elsewhere in which the evaporation has been said to be as high as 2.25 lb. per brake horse-power hour, but nothing was said as to the efficiency of the engine itself. Dr. Morley concluded by saying that his remarks must not be considered as disparaging the exhaust gas boiler. On the contrary, he believed it was an appliance very much to be recommended.

Obituary.

SIR FRANCIS BARKER.

We regret to have to announce the death of Sir Francis Henry Barker, a director of Vickers Limited, which took place at Cannes on January 28th. Sir Francis had been ill for some considerable time, having undergone an operation last year, from which, however, he seemed to be making a good recovery. He went to Cannes for his convalescence, and there a second operation was found to be necessary, from the effects of which he never rallied. He was born at Smyrna in June, 1865, and was the second son of the late Alfred Barker, of Constantinople and Elmfield, Esher. He was educated privately and at Clifton College, and received his early business training in his father's bank in Constantinople. Subsequently he became private and confidential secretary to Sir Edgar Vincent (the present Lord D'Abernon), at that time Director-General of the Imperial Ottoman Bank at Constantinople. During this period he travelled extensively in Syria and other parts of Asia Minor.

In 1899 the Parsons' Foreign Patents Company, Limited, was formed to exploit on the Continent of Europe Sir Charles Parsons' patents for marine and land turbine work. Sir Francis Barker was appointed manager of this company, and as such was instrumental in forming subsidiary companies in various foreign countries and in establishing works for the manufacture of land and marine turbines under the Parsons' patents. He maintained his association with the Parsons' Foreign Patents Company, Limited, to the end, and at the time of his death was a director of the company. In Russia, and especially in Russo-British affairs, he always evinced the liveliest interest. He was president of the British Russia Club, and chairman of the executive council of the Russo-British Chamber of Commerce.

Reported Patent Cases.

DURING 1921 patent litigation revived to a certain extent, and a number of important decisions were given. At the same time, an increase in the number of patent applications filed was noted in comparison with former years. The following table gives the total number for recent years, namely :—

1913	30,102	1918	21,933
1914	24,847	1919	32,892
1915	18,225	1920	36,680*
1916	18,686	1921	35,163
1917	19,358		

* Peace Treaty applications.

Referring to reported cases, we find decisions as follows :

Bonnard v. *London General Omnibus Company.*—The defendants were successful in showing that they did not infringe a patent for a guard for a motor vehicle consisting of a frame or the like carried along the side of the vehicle and crossing the path of the rear wheels at a slight inclination. They used such an arrangement, but pleaded there was no subject matter in the patent.

Dixon's and Baxter's Patents relating to Electric Capstans.—These were extended for four years, although the patents expired in 1918.

Gunston v. *Winox, Limited.*—This was an action for an infringement of design of a show-card, and on appeal it was held that the registration was invalid, because of a previous disclosure which was not confidential. This illustrates the importance of making sure that any disclosure of a design or indeed of an invention, should only be made in the circumstances of strict confidence before the application for registration of a design or protection for the invention has been lodged.

Fleming v. *Doig.*—This was an action based on a verbal agreement for license in which it was held that the agreement had been proved, and that the plaintiff was entitled to a royalty on a patent relating to winches for operating the rope of a duplex derrick.

Simplex Lithographic Company v. *Causton and Sons.*—In this action a sample card for displaying textile fabrics came into question. It consisted of an embossed panel struck up from the body portion, having a surface forming a replica of a sample of textile material. It was held that there was no invention in such an arrangement.

Roth v. *Cracknell.*—The patent in suit in this action was for a vacuum cleaner with a single acting bellows, the upper end being provided with a handle and being slidable on a rod secured to the lower end. It was proved that the plaintiff's machine was very useful, that it was for a combination of six elements, which had been taken by the defendant. The patent was upheld.

Spiro-Turbine, Limited, v. *The Sullivan Machinery Company.*—An unusual feature presented itself in this case which related to a rotary engine comprising rotors mounted on shafts, and having intermeshing toothed blades forming closed pockets, which increased in volume as the rotors rotated, so that having regard to the position of a port in the surrounding casing, continuous expansion of the motive fluid was secured. At the trial it appeared that this continuous expansion had already been secured in a somewhat similar construction, and the Court of Appeal confirming the decision of the first Court, held that the patent was invalid.

Hope's Patent.—This related to fastenings for casement windows, and an extension of three years was granted in view of the patentee having been engaged on work of national importance during the war.

Aluminium Schweissung v. *Aluminium Company.*—The Court of Appeal considered a patent in this action for the autogenous fusing of aluminium by means of a flux consisting of a mixture of alkaline chlorides. The matter was heavily contested, large numbers of experiments being gone into, particularly in the first Court, but the patent, and a later patent for a modification, were held valid.

Wallace v. *Tullis Russell and Co.*—The claim was for removing digested material in the working of esparto for paper making from digesters by subjecting the material to the action of streams of water. It was held in the Court of Session in Scotland that this application of jets of water was ingenious and proper subject matter for a patent, and that it was novel and useful. On the other hand, the Court found that the patent was bad in that the method of using the jets through the discharge opening of the digester was not sufficiently described, and that the specification did not disclose any effective method of carrying out the subject matter of the patent. Under these circumstances the patent was not entitled to the protection sought.

Higginson v. *Bentley.*—This patent related to liquid fuel supply arrangements for internal combustion engines, and was held by Mr. Justice Sargant to be valid and infringed.

Moore Filter Company v. *Great Boulder Gold Mines, Limited.*—An appeal from the Supreme Court of Western Australia was dismissed and a patent which related to a filtering system held invalid. There were twenty-five claims to the patent based on United States practice rather than British practice.

Anilin Fabrikation v. *Levinstein.*—This appeal, which had been suspended during the war, was dismissed. The patent was for black colouring matter directly dyeing cotton by boiling a specified dinitrophenol with an aqueous solution of sulphur and a sulphide of an alkali metal. The patent was held valid but not infringed.

Cookeley v. *Crowthorn.*—The patent relates to driving gear for a chain mortising machine. It was restored under the Treaty of Peace Rules, and the defendants were held to have infringed a combination claim by assembling parts after the restoration.

Hamer v. *Howorth.*—This action related to means for maintaining tight joints at the front ends of the side flues of steam generators. It was found that the patent contained novelty and was useful, but that it had not been infringed.

Horne v. *Johnston Brothers.*—This was an unusual action relating to threats in respect of quick release mechanism for the draught attachment of road vehicles.

THE BRITISH CAST IRON RESEARCH ASSOCIATION.

THE Director of Research reports that the character of the problems submitted for investigation and advice continue to be of general interest and importance, and during the month of December a large batch of problems reached him. It is particularly, he remarks, noticeable that defects associated with unsoundness, porosity and shrinkage continue to trouble the industry. Examples of such difficulties in heavy and light castings and in malleable work were submitted and help sought in the remedy of the defects. The variable practice in cupola operations, in the preparation of facing and core sands for definite types of castings was again illustrated in several of the problems submitted. The synthetic preparation of sands and linings for high-temperature work is under consideration, and trials based on recent refractory research results have been suggested.

In the domain of the light castings foundry problems connected with mixtures, and treatment for light castings subject to shock, were investigated and advice given. Certain abnormal structures in heavy and light grey iron and malleable castings were submitted for investigation and advice tendered. Problems associated with the chemical analysis and testing of cast iron were also dealt with. In many of the above cases data of a specially useful character were obtained, such as are of service to the researches on moulding sands, cupola linings, shrinkage and draws, and the pig iron grading problems. The influence of design was of signal importance in some of the troubles experienced, and full particulars supplied in several of the most intricate problems under investigation materially helped the director in his conclusions.

Work is proceeding on the main problems of research, and data continue to arrive from members such as are of practical assistance in the carrying out of these somewhat lengthy researches. The additions to the library were numerous, and the entries in the index of the Bureau of Information now number several thousands. This information is now being made good use of regularly by the members.

THE JUBILEE OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

THE following programme has been arranged in connection with the commemoration during the present month of the first meeting of the Society of Telegraph Engineers, which was held on February 28th, 1872. On Tuesday, February 21st, an experimental lecture will be delivered by Professor J. A. Fleming, F.R.S., on "Michael Faraday and the Foundations of Electrical Engineering." In the evening the annual dinner of the Institution will be held at the Hotel Cecil, Strand, W.C., at 7 p.m. (for 7.30 p.m.). On Wednesday, the 22nd, from 3.30 to 6 p.m., there will be a series of short discourses on "Reminiscences and Experiences of Electrical Engineering in both its Technical and Legislative Aspects," and at 8.30 p.m. Professor Fleming will repeat his lecture of the previous day. On Thursday, the 23rd, from 3.30 to 6 p.m., and again from 8 to 10 p.m., the discourses on electrical engineering will be continued. These reminiscences should prove to be of great interest, as it is hoped that there will be over forty speakers, many of whom have been connected with the electrical industry since its inception.

A limited number of tickets will be available for visitors introduced by members. Early application for such tickets—not more than one per member—should be made to the secretary. The tickets will be posted as soon as possible after February 10th, and in the event of the applications being in excess of the number of tickets available, a Committee of Selection will allot the tickets. No tickets will be required for members.

BOOKS RECEIVED.

Patents and Chemical Research. By H. E. Potts. Liverpool: At the University Press. Price 8s. 6d. net.

Applied Calculus. An introductory text-book. By F. F. P. Bisacre. London: Blackie and Son, Limited, 50, Old Bailey, E.C. 4. Price 10s. 6d. net.

The Analysis of Coal and its By-products. By S. Roy Illingworth, assisted by Jenkyn Griffiths, with a foreword by Sir Robert Robertson, K.B.E., F.R.S. London: The Colliery Guardian Company, Limited, 30–31, Furnival-street, E.C. 4. Price 21s. net.

THREE-CYLINDER EIGHT-COUPLED LOCOMOTIVE FOR SPAIN

THE YORKSHIRE ENGINE COMPANY, LIMITED, SHEFFIELD, ENGINEERS

Three-Cylinder Locomotive for Spanish Railways.

THE increased use of three single-expansion cylinders is a noticeable feature of advanced European locomotive design, more particularly in Great Britain and Germany. A recent example built in this country is illustrated herewith and in our two-page Supplement. This locomotive, of the 4-8-0 type, with a double bogie tender, has been designed and built by the Yorkshire Engine Company, Limited, Meadow Hall Works, Sheffield, to the order of Babcock and Wilcox, Limited, London, on behalf of their associated Spanish company, for service on Spanish railways.

In recent times the Spanish Government has set up tariffs on imported goods, with a view to fostering the manufacture of all possible commodities, including locomotives, in Spain, and in order to participate in this business, La Sociedad Española de Construcciones Babcock y Wilcox determined to include locomotive building in its programme at its new works at Bilbao. It also decided to put forward an actual locomotive of high power to meet the conditions prevailing on the principal Spanish railways, with a view, if possible, to making it a basis for its manufacturing further locomotives of this type. This engine is the subject of the present article.

The two most important railways in Spain are the Norte and the Madrid Zaragoza y Alicante, and the conditions on both lines demand the use of extremely powerful engines, combined with restricted axle load. The minimum radius of the curves is 200 m. at stations, and the gradients are long and severe. On the Norte Railway the axle load is restricted to 15.8 metric tons, and the weight per metre run on the total length over engine and tender buffers to 6 metric tons, whilst on the Madrid Zaragoza y Alicante Railway there is an axle load limit of 16 metric tons. It will be seen that these conditions are such as to enable the advantages peculiar to the three-cylinder locomotive to be fully exploited.

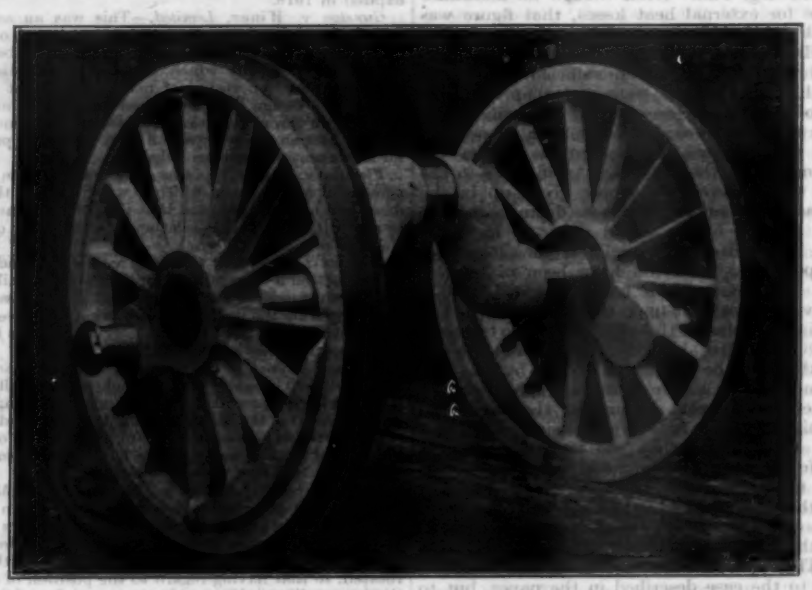
In the engine produced by the Yorkshire Engine Company the cylinders all have the same bore and stroke, namely, 20½in. by 26in. The inside cylinder is inclined at 1 in 15, and drives the first coupled axle, whilst the two outside cylinders are horizontal and are connected to the second coupled axle. In order to permit the use of a reasonably long connecting-rod for the inside cylinder, the latter is placed some distance in advance of the outside cylinders.

Each cylinder casting is separate, but the inside one is combined with the smoke-box saddle in order to simplify the steam and exhaust passages. Only two steam pipes are used in the smoke-box, as is usual for two-cylinder engines, and these are connected to the inside casting. Each passage divides into two, one portion leading to the inside steam chest, and the other, by means of a short connecting pipe, to the corresponding outside steam chest. The exhaust passages, as will be seen in the Supplement, are very direct. An automatic by-pass valve is fitted to each cylinder. This valve is kept closed by the pressure in the steam chest when the regulator is open, and is opened by the boiler pressure when the regulator is closed or when excessive compression arises.

Duplication of parts has been aimed at wherever possible, and to this end the cylinder and steam chest covers, the pistons and rods, the piston valves and the spindles have been made interchangeable. Great attention has also been paid to the design of all the moving parts with a view to combining lightness with strength and durability, and in order to minimise the masses to be balanced. The pistons are of forged steel, conical in section, and machined all over. The piston valves are of the hollow type with forged steel heads, machined all over, and welded to a piece of solid drawn tube. They provide an illustration of the success with which lightness has been attained in the moving parts. All three crossheads are of the two-bar type. The connecting-rods have solid bushed small ends and strapped large ends.

The valve gear for the outside cylinders is of the Walschaerts type. A feature of interest in connection with it is the fact that the whole of the motion is symmetrical about one centre line, except that the excentric rods are ¼in. out of centre, a departure which is partly counteracted by their bodies being of channel section with the neutral axis approximating to the centre of application of the load.

The motion of the valve of the inside cylinder is obtained from the motion of the outside valve spindles by means of a rocking shaft carried in fixed bearings and driven from one side of the engine. This shaft has arms in the ratio of 2 to 1, and carries a floating shaft in bearings formed on its short arms. The floating shaft has equal arms, and is actuated from the other side of the engine. It will be observed from reference to the cross section through the boiler barrel that both the rocking and floating shafts have forked ends which surround the radius rods. This plan may appear a rather expensive piece of design, but it was thought worth while in order to preserve the straight line motion and obviate the use of excentrically loaded pins. The arrangement of this novel type of valve motion behind the cylinders enables any of the three piston valves to be withdrawn for examination without disturbing the gear, and makes unnecessary any allowance for expansion in setting the inside valve such as is required with some forms. Moreover, all journals are horizontal and the angular movements and inertia of the parts are small. The valve spindle guides are, in all three cases, integral with the hind valve chest covers.



CRANK AXLE OF THREE-CYLINDER LOCOMOTIVE

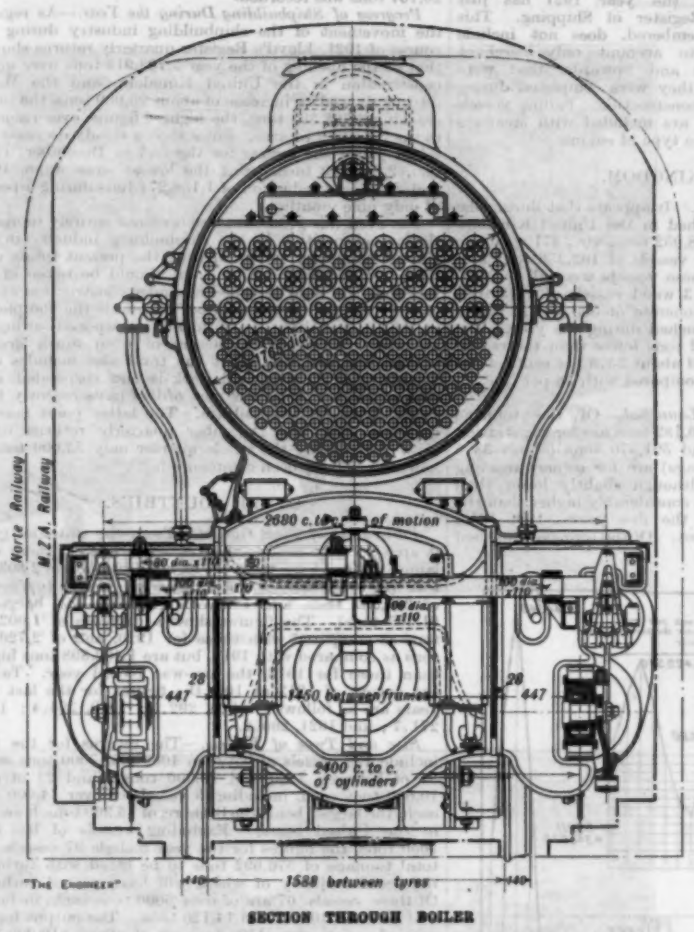
The crank axle, as shown in the accompanying half-tone engraving, is circular in section throughout, and is formed from a single forged cylindrical piece, bent to shape. This construction ensures that the grain of the material runs parallel with the centre line of the axle and should ensure long service. All the axle-boxes on the engine are of cast steel with phosphor-bronze bearings. Lubrication is effected by means of "Armstrong" pads contained in the bottom oil reservoirs, which can be removed for examination without lifting the engine.

The main frames are of steel plate 1¼in. thick, and are well stayed together, a noteworthy feature being the provision of racking stays between the outside cylinders and the driving wheels. The bearing springs for the coupled wheels are all underhung with links in tension, and are equalised in two groups. The bogie is of the cross-slide type, with one bearing spring on each side carried from a forged steel compensating beam which rests at each end on top of the axle-boxes. The side play is 2½in. each way, and is controlled by a full elliptic laminated spring. Further provision for the negotiation of curves is made by allowing ¾in. side play each way in the trailing axle.

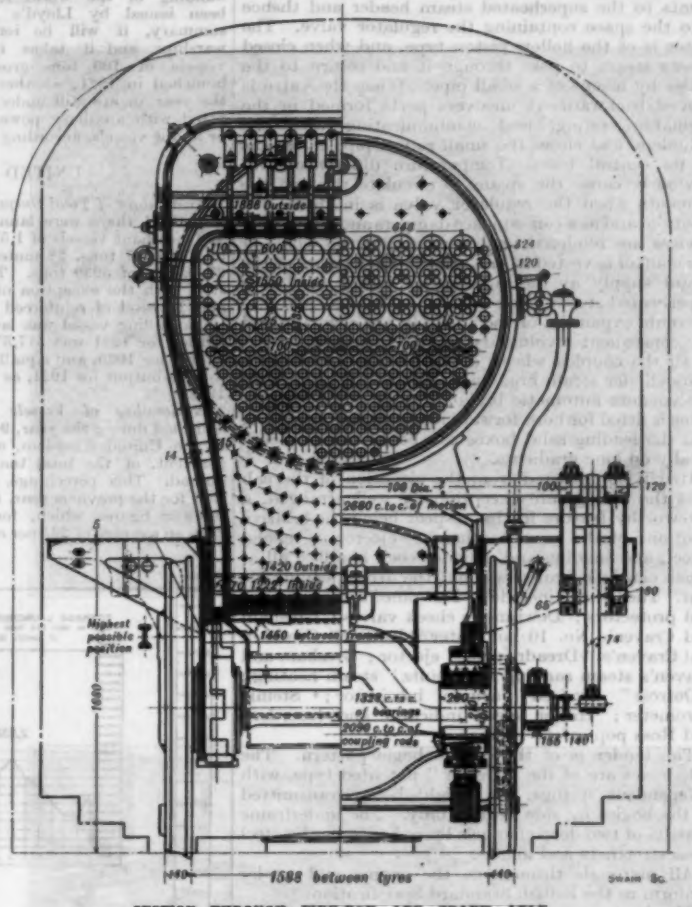
A tariff has recently been imposed in Spain on all imported coal, and this fact makes the use of Spanish coal almost compulsory on the railways. As this coal is of inferior quality, a large grate area is essential for efficient combustion, as are ample fire-box volume and a good depth between the brick arch and the fire-grate. To this end the "Orleans" type of fire-box is used, as is the case in a number of successful engines now in service on the Norte Railway. In this design of fire-box the fire-grate is narrower at the front than at the back. The fire-box shell is of the "Belpaire" type, with raised top to give increased steam space above the area of maximum steam generation.

The superheater and regulator are of Babcock and Wilcox's patented design, and are of an entirely new type, embodying the experience derived from the design and working of some twenty thousand superheaters in the firm's land and marine boilers. As shown in the Supplement, the saturated and super-

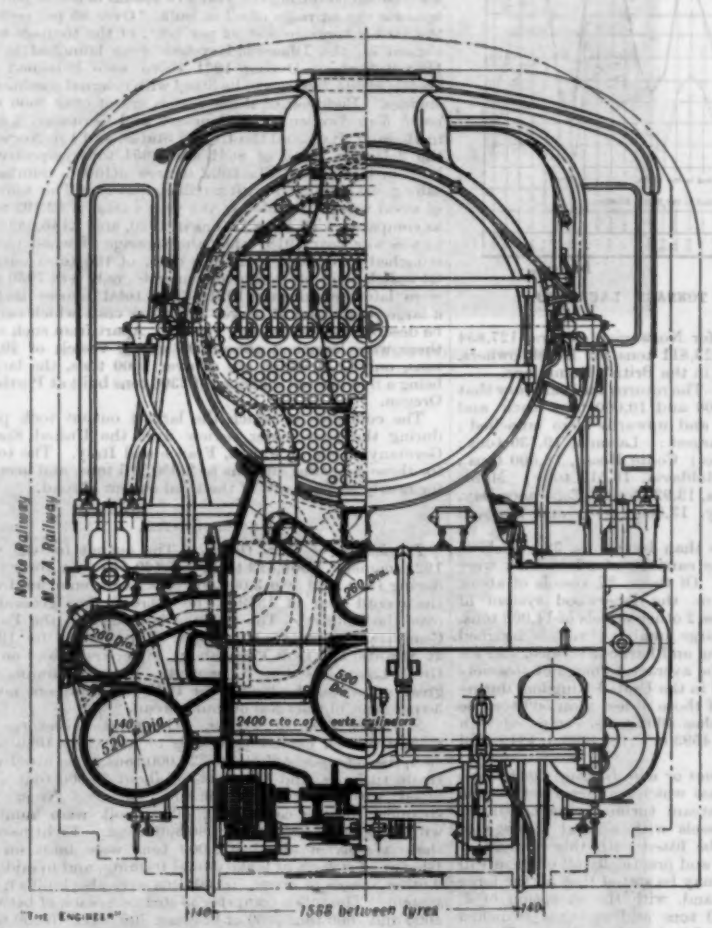
THREE-CYLINDER EIGHT-COUPLED LOCOMOTIVE FOR SPAIN



SECTION THROUGH BOILER

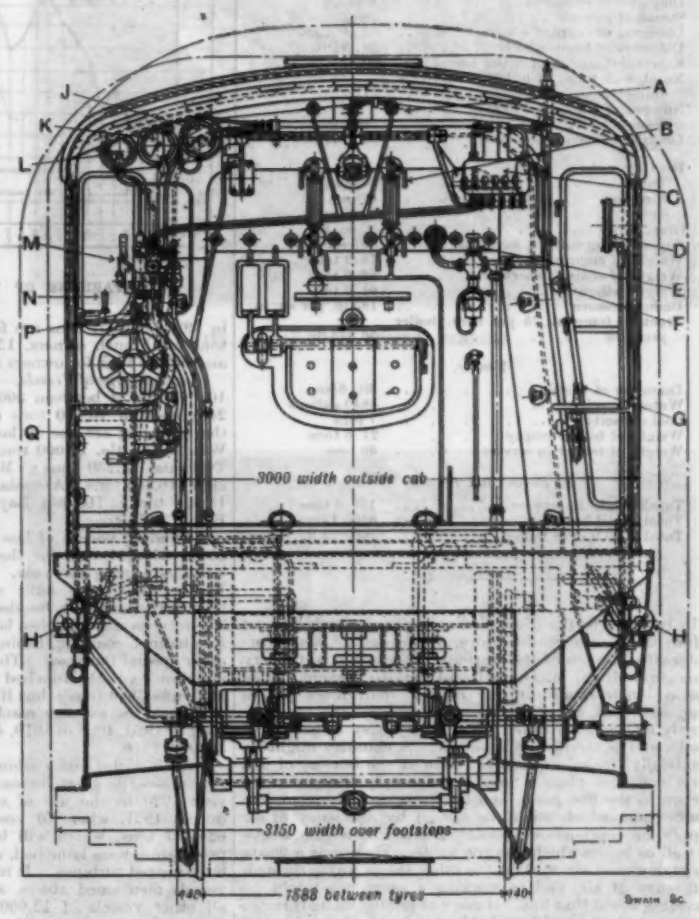


SECTION THROUGH FIRE-BOX AND CRANK AXLE



A.—Injector steam cocks.
B.—Dewrance's water gauges.
C.—Six-feed vacuum lubricator, capacity 6 pints.
D.—Hasler speed indicator and recorder.
E.—Heintz steam heating.
F.—Blower cock.
G.—Drop grate handle.
H H.—Gresham and Craven's No. 10 hot water injectors.

HALF-SECTION THROUGH CYLINDERS AND HALF-FRONT VIEW



J.—Steam pressure gauge.
K.—Steinle pyrometer.
L.—Duplex vacuum gauge.
M.—30/20 Dreadnought ejector with steam brake valve.
N.—Leading sanding handle.
P.—Cylinder cock handle.
Q.—Steam sanding valve.

ARRANGEMENTS IN THE CAB

heated steam portions of the header are entirely separate. They are made of forged steel, and are secured to the regulator casting, which is of cast steel. Steam is collected from the top of the dome and passes by way of the saturated steam header and the elements to the superheated steam header and thence into the space containing the regulator valve. The latter is of the hollow piston type, and when closed allows steam to pass through it and return to the boiler by means of a small pipe. When the valve is moved backwards it uncovers ports formed in the regulator casting, and communicating with the cylinders, and closes the small return pipe by means of its central boss. Temperature differences will obviously cause the steam to circulate through the elements when the regulator valve is in the closed position, and as a consequence dampers and circulating devices are rendered unnecessary, and the whole of the control is vested in one valve. The control of the steam supply at the superheater outlet results in superheated steam being instantly available, and also prevents expansion of the steam in the elements and the consequent involuntary starting of the engine.

All the coupled wheels are braked by means of a two-cylinder steam brake acting in conjunction with the vacuum automatic brake. Steam sanding apparatus is fitted for both forward and backward running, and the leading sand boxes can be operated mechanically on long gradients.

It will be gathered from the elevation of the cab that the fittings are exceptionally well arranged, a noteworthy feature in this respect being the relative positions of the regulator handle, ejector, reversing wheel, and sanding and cylinder cock handles, all of which can be operated without the driver leaving his seat. The fittings include :—Dewrance's water gauges and protectors ; Dewrance's check valves ; Gresham and Craven's No. 10 hot water injectors ; Gresham and Craven's "Dreadnought" ejector ; Gresham and Craven's steam sanding ; "Heintz" steam heating ; "Detroit" six-feed vacuum lubricator ; Steinle pyrometer ; Hasler speed indicator and recorder ; and Ross pop safety valves.

The tender is of the double bogie pattern. The axle-boxes are of the "Iracier" patented type, with independent springs, the weight being transmitted to the bogies by side bearers only. The underframe consists of two deep channels braced together by steel cross stretchers and angles.

All materials throughout the engine and tender conform to the British Standard Specification.

The leading particulars of the engine and tender are :—

Locomotive.

Number of cylinders	Three
Diameter of cylinders	20½in.
Stroke of pistons	26in.
Diameter of coupled wheels	5ft. 1⁷/₁₆in.
Diameter of bogie wheels	2ft. 9⅝in.
External diameter of boiler barrel	5ft. 10⅝in.
Number of tubes of 0.133 m. external diameter	27
Number of tubes of 0.050 m. external diameter	218
Length between tube plates	16ft. 4⅛in.
Heating surface—	
Tubes	2450 sq. ft.
Fire-box	198 sq. ft.
Total	2648 sq. ft.
Grate area	50 sq. ft.
Superheating surface, external	507 sq. ft.
Weight of engine empty	78.2 tons
Weight of engine in service	86.6 tons
Weight adhesive	61.0 tons
Boiler pressure	185 lb. per sq. in.
Tractive force at 75 per cent. boiler pressure	36,873 lb.

Tender.

Diameter of wheels	3ft. 6½in.
Water capacity	4840 gallons
Coal capacity	7 tons
Weight of tender empty	21.6 tons
Weight of tender in service	50 tons

Engine and Tender.

Total weight in service	136.6 tons
Total wheel base	62ft. 1½in.
Total length over buffers	76ft. 2½in.

IN replying to the discussion on a paper which he read before the South Staffordshire, Warwickshire and Worcestershire Branch of the National Association of Colliery Managers, Mr. S. M. Duguid said that to prevent smoke was a much more difficult matter than most people imagined, that was if they wished to burn the coal efficiently at the same time. It was very easy to get rid of smoke at the sacrifice of economy. A chimney might be practically smokeless, and yet have at the bottom of it a very inefficient plant. Smoke was simply finely divided carbon in the flue gases, and that was due to incomplete combustion, which might be caused by deficiency of air supply or combustion space. There was a line above as well as below which one got waste. There was a waste through excess air, and on the other side a waste through deficiency of air, and in working a plant one might be wavering about that line. If one was getting waste through excess air there would probably not be black smoke, but if the waste was through deficiency of air then there would be smoke. One could get rid of smoke at the cost of efficiency. The Lancashire boiler was particularly apt to cause black smoke on account of its confined combustion chamber. In any case it was very difficult to get rid of smoke and at the same time to keep up the highest efficiency. It was not impossible, but it required exceptionally great care.

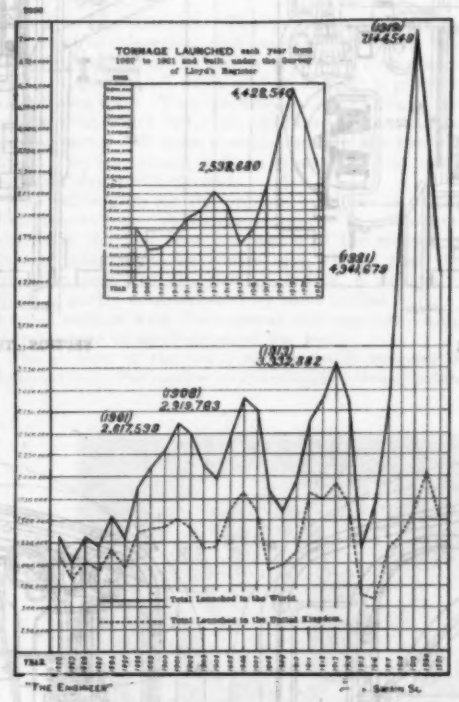
Lloyd's Register Annual Summary.

THE usual annual summary of the mercantile shipbuilding of the world for the year 1921 has just been issued by Lloyd's Register of Shipping. This summary, it will be remembered, does not include warships, and it takes into account only merchant vessels of 100 tons gross and upwards, that were launched in 1921, whether they were completed during the year, or are still under construction. Sailing vessels fitted with auxiliary power are included with steamers or motor vessels, according to type of engine

UNITED KINGDOM.

Particulars of Total Output.—It appears that during the year 1921 there were launched in the United Kingdom 426 merchant vessels of 1,538,052 tons, viz., 371 steamers of 1,429,757 tons, 28 motor vessels of 102,356 tons and 27 barges of 5939 tons. These vessels were all built of steel with the exception of 3 wood vessels of 1273 tons and 1 vessel of reinforced concrete of 300 tons. Not a single sailing vessel was launched during the year. The output for 1921 was 517,572 tons lower than the record figures for 1920, and equalled about 35.5 per cent. of the world's output for 1921, as compared with 58 per cent. in 1913.

Nationality of Vessels Launched.—Of the tonnage launched during the year, 946,182 tons are for registration in the United Kingdom, and 591,870 tons (about 38.5 per cent. of the total tonnage) are for owners residing abroad. This percentage, although slightly lower than that for the previous year, is considerably higher than the pre-war figures which, for the five years, 1909–1913, gave an average of 22½ per cent. Of the tonnage launched



COMPARISONS OF TONNAGE LAUNCHED

in 1921, 134,551 tons are for Norwegian owners, 127,854 tons for French owners, 123,811 tons for Dutch owners, and 66,373 tons for owners in the British Dominions.

Size and Type of Vessels.—The returns for 1921 show that 103 vessels of between 5000 and 10,000 tons each and 24 vessels of 10,000 tons and upwards were launched ; the following are the 10 largest :—Laconia, 19,730 tons ; Windsor Castle, 19,000 tons ; Conte Rosso, 18,500 tons ; Tuscania, 17,250 tons ; Moldavia, 16,510 tons ; Montclare, 16,400 tons ; Antonia, 13,920 tons ; Esperance Bay, 13,850 tons ; Hobson Bay, 13,850 tons ; and Moreton Bay, 13,850 tons.

Excluding vessels of less than 1000 tons, 38 vessels of about 250,500 tons for the carriage of oil in bulk were launched during the year. Of them, 27 vessels of about 195,000 tons were built on the Isherwood system of longitudinal framing, besides 2 other vessels of 14,000 tons. The returns also include a large number of vessels designed for channel, coasting, fishing and harbour service, and for other special purposes. The average tonnage of steamers and motor vessels launched in the United Kingdom during 1921 was 3840 tons ; but if those of less than 500 tons be excluded, the average reaches 4602 tons, compared with 4387 in 1920, 4006 in 1919, 4593 in 1918, 4933 in 1917, and 4080 in 1916.

Vessels Fitted with Turbines or with Internal Combustion Engines.—The great increase which was recorded for the year 1920 in the use of steam turbines was continued during 1921, when 70 vessels with a total tonnage of 624,487 tons, which will be fitted with this method of propulsion, were launched, and practically all of them will have geared turbines. It may be stated that all the large vessels mentioned above, and, with the exception of 2, all other vessels of 12,000 tons and upwards launched during the year, are to be fitted with turbines. During the year, 28 motor vessels of 102,356 tons were launched, and 11 of them are of 5000 tons and upwards, the largest being of about 9500 tons.

Output of Leading Ports.—The Glasgow district occupies first place amongst the shipbuilding centres of the country, showing an output of 358,347 tons. Then follow Newcastle (354,813 tons), Greenock (146,842 tons), Sunderland (144,280 tons), Middlesbrough (129,559 tons), and Belfast (93,373 tons). The largest decrease as compared with 1920, took place on the Clyde, the figures for which are 175,277 tons lower than the previous year. The decrease for the Wear was 170,174 tons, and for the Tees 105,013 tons, while in the Barrow district an actual increase of 26,137 tons was recorded.

Progress of Shipbuilding During the Year.—As regards the movement of the shipbuilding industry during the course of 1921, Lloyd's Register quarterly returns showed that at the opening of the year 3,708,916 tons were under construction in the United Kingdom, and the March returns showed an increase of about 90,000 tons, the totals reaching 3,798,593 tons, the highest figures ever recorded in the Society's returns. Since then a steady decrease has taken place, the figures for the end of December, 1921, viz., 2,640,319 tons, being the lowest since June, 1919, and showing a reduction of 1,158,274 tons during a period of only nine months.

But even this great decrease does not entirely represent the actual position of the shipbuilding industry in the United Kingdom. In comparing the present totals with those for normal years, account should be taken of the fact that the total returned as under construction at the end of 1921 included a number of vessels the completion of which had been exceptionally postponed owing to abnormal causes. Two factors of even much greater importance, are, first, that the total also includes over 720,000 tons on which all work is now suspended, and, second, that so very few new orders have recently been received by the shipbuilders. The latter point may be gathered from the December quarterly returns which show that during the whole quarter only 55,000 tons of new vessels have been commenced.

OTHER COUNTRIES.

Particulars of Total Output.—From the statistics given it appears that outside the United Kingdom, there were launched during the year, 951 merchant vessels of 2,803,627 tons (698 steamers of 2,537,976 tons, 108 motor vessels of 204,286 tons, and 145 sailing vessels and barges of 61,365 tons). The figures show a decrease of 1,002,415 tons as compared with those for 1920, and of 2,720,480 tons as compared with 1919, but are 1,402,898 tons higher than those for 1913, the pre-war record year. Taking the output of 1913 at 100, the figures for the last four years are as follows :—1918, 292.6 ; 1919, 394.4 ; 1920, 271.7 ; and 1921, 200.2.

Size and Type of Vessels.—The returns for the year include 198 vessels of between 4000 and 7000 tons each ; 96 of between 7000 and 10,000 tons ; and 23 of over 10,000 tons each, including 5 vessels of over 14,000 tons each, the largest being the Bethore, of 15,300 tons, launched in the United States. Excluding vessels of less than 1000 tons, the figures for the year include 97 vessels of a total tonnage of 570,692 tons to be fitted with turbines, the great majority of which will have geared turbines. Of these vessels, 67 are of over 5000 tons each, including 8 of between 10,000 and 14,120 tons. The output for the year also comprises 110 steamers of about 810,000 tons built on the Isherwood system of longitudinal framing. Including 92 of these vessels of about 704,000 tons, there were launched during the year 113 vessels of about 800,000 tons for the carriage of oil in bulk. Over 86 per cent. of the tanker tonnage and 92 per cent. of the tonnage built abroad on the Isherwood system were launched in the United States. During 1921 there were launched 108 vessels of 204,286 tons to be fitted with internal combustion engines. Eighteen of these vessels are of over 5000 tons each. 5 in Sweden, 3 in Denmark and Germany, 2 each in Holland, Italy and the United States, and 1 in Norway ; the 2 largest being of 8681 and 8654 tons respectively, built in Denmark. The total figures include a number of sailing vessels fitted with auxiliary power. The tonnage of wood vessels included in the year's total is 52,193 tons, as compared with 133,827 tons in 1920, and 1,145,582 tons in the war year 1918, when the tonnage of wood vessels launched amounted to 28 per cent. of the total output. Of vessels built of reinforced concrete, only 8 of 7950 tons were launched during 1921. The total figures include a large proportion of barges and other craft which cannot be described as real sailing vessels. Apart from such craft there were launched abroad 96 sailing vessels of 29,220 tons, only 3 of which are of over 1000 tons, the largest being a five-masted schooner of 2300 tons built at Portland, Oregon.

The countries in which the largest output took place during the year under review were the United States, Germany, Holland, Japan, France and Italy. The totals for these countries amount to 2,350,715 tons, and account for nearly 84 per cent. of the total output abroad.

UNITED STATES.

Particulars of Total Output.—The output for the year 1921, namely, 1,606,413 tons, is 1,469,840 tons lower than during 1920, and over 3,000,000 tons less as compared with the record year of 1919. The decrease was general all over the country. The tonnage launched on the Pacific Coast represented 55.7 per cent. of the output for 1920 ; at Atlantic and Gulf Ports about 38 per cent., and on the Great Lakes less than 9 per cent. Notwithstanding this great reduction the figures for 1921 still represent nearly 36 per cent. of the total output abroad.

Size and Type of Vessels.—The total figures for the United States, excluding vessels of less than 1000 tons, comprise 33 vessels of about 228,000 tons to be fitted with steam turbines, and 11 vessels of about 35,000 tons to be fitted with internal combustion engines. Ninety-two steamers for the carriage of oil in bulk were launched with a tonnage of about 690,000 tons. Eighty-six of these vessels of about 670,000 tons were built on the Isherwood system of longitudinal framing, and in addition 9 other vessels of about 76,000 tons were also built on this system. The totals comprise 53 steamers, each of between 4000 and 7000 tons ; 50 of between 7000 and 10,000 tons, and 18 vessels of 10,000 tons and upwards including the ss. Bethore, of 15,300 tons, launched by the Bethlehem S.B. Corporation, at Sparrow's Point, Md., this being, as already mentioned, the largest vessel launched abroad during 1921.

GERMANY.

Figures for this country are published for the first time since 1913. During the year under review 242 vessels

OVERHAULING DEPOT OF THE LONDON GENERAL OMNIBUS CO.

(For description see page 121)

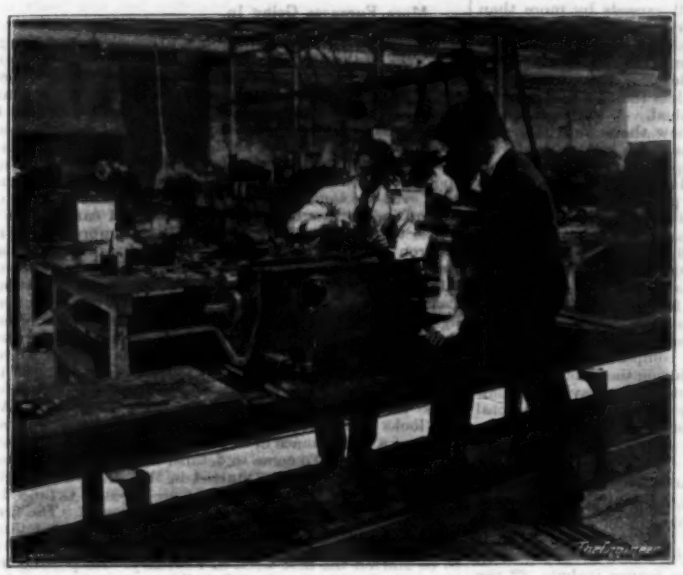


FIG. 14—ENGINE CONVEYOR

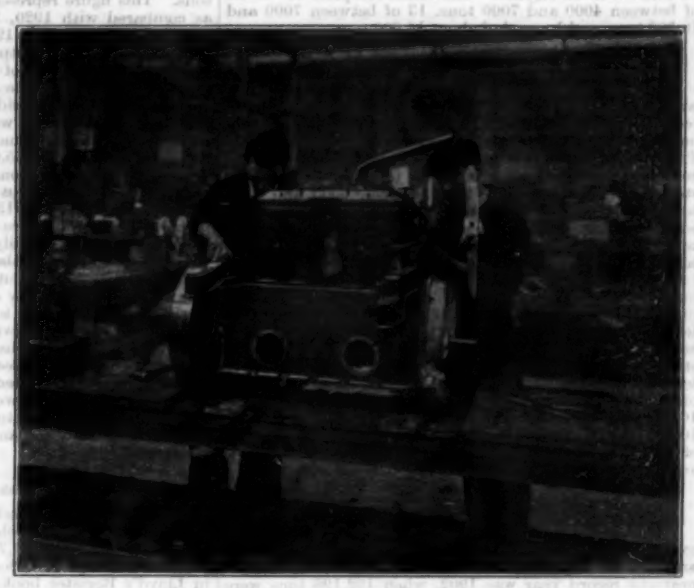


FIG. 15—ENGINE CONVEYOR

FIG. 16—REAMERING AND CRANK-FITTING MACHINE

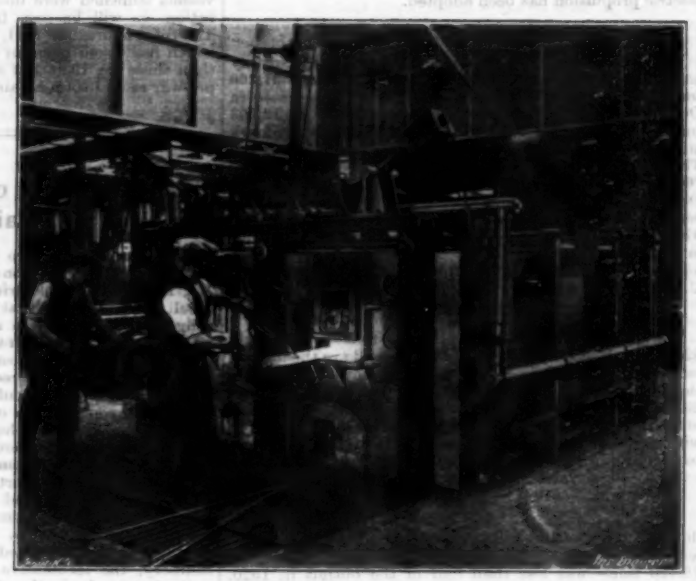


FIG. 17—GAS-FIRED SPRING FURNACE

FIG. 18—TESTING REPAIRED SPRINGS

FIG. 19—ENGINE STARTING DEVICE AT END OF CONVEYOR

of 509,064 tons were launched. As compared with the output for 1913, the present figures are about 44,000 tons higher and represent over 18 per cent. of the total output abroad during 1921. Apart from vessels of less than 1000 tons, the figures include 17 vessels of 72,777 tons to be fitted with steam turbines and 7 vessels of 28,839 tons to be fitted with oil engines. The totals comprise 40 vessels of between 4000 and 7000 tons, 13 of between 7000 and 10,000 tons, and 1 vessel of about 14,000 tons.

HOLLAND.

The total tonnage launched during 1921—232,402 tons—was 49,000 tons higher than the 1920 figures, and is a record. As usual, the figures for the country do not include vessels exclusively intended for river navigation. The total figures, excluding vessels of less than 1000 tons comprise 13 vessels, of about 81,000 tons, to be fitted with steam turbines, including 9 of between 6000 and 8500 tons, and also 3 vessels of about 12,500 tons to be fitted with oil engines. Sixteen vessels of between 4000 and 7000 tons each were launched, and 4 of between 8000 and 9600 tons.

JAPAN.

The output for Japan—227,425 tons—was 229,217 tons less than in 1920, a reduction of over 50 per cent. As compared, however, with pre-war years the present output still exceeded the combined figures for the 4 years 1910–13 by over 30,000 tons. The 1921 totals comprise 21 vessels of between 4000 and 7000 tons each, 8 of between 7000 and 10,000 tons each, and 2 turbine-engined vessels of between 10,000 and 10,500 tons each. These figures include 5 vessels of 43,683 tons which will be fitted with steam turbines, and 3 vessels of 21,058 built for carrying oil in bulk.

FRANCE.

The output in France for the year—210,663 tons—exceeded the totals for 1920 by 117,214 tons (125 per cent.), and was the highest ever reached in that country. The previous record year was 1902, when 192,196 tons were launched; that total, however, included over 146,000 tons of sailing vessels. The total figures include 11 steamers of between 4000 and 7000 tons, 11 of between 7000 and 10,000 tons, and one of 10,741 tons. Eleven vessels of 62,882 tons will be fitted with steam turbines, including 2—1 of 10,741 tons and 1 of 4618 tons—for which turbo-electric propulsion has been adopted.

SCANDINAVIAN COUNTRIES.

The total tonnage launched in Denmark, Norway and Sweden amounted to 194,607 tons, which is 31,260 tons higher than the output for 1920. The increase in Denmark amounted to 16,569 tons, in Norway to 12,603 tons, and in Sweden to 2088 tons. As regards Denmark and Sweden the year's figures are the highest on record. The total figures include 8 vessels of between 4000 and 7000 tons each launched in Sweden, 3 in Norway and 2 in Denmark, in which country were also launched 3 motor vessels of over 7000 tons each, the 2 largest of about 8700 tons each. The tonnage of steel vessels fitted with internal combustion engines launched in Denmark—45,113 tons—was the largest for any country outside the United Kingdom.

ITALY.

The total figures for Italy—164,748 tons—were nearly 32,000 tons higher than those for 1920, and are the highest on record. About 25 per cent. of the total represented the output of the Trieste district. The totals comprise 23 steamers of between 4000 and 7000 tons and 1 vessel of 7756 tons. Eight vessels of 43,620 tons are to be fitted with steam turbines, and 4 vessels of 24,512 tons are built to carry oil in bulk.

BRITISH DOMINIONS.

The total tonnage launched in all the British Dominions during 1921, namely, 129,675 tons, was about 74,000 tons less than in 1920. The tonnage launched in Canada—78,420 tons—was less than half of the output in 1920. On the coast and on the St. Lawrence were launched 11 steel steamers of between 4000 and 7000 tons, and 1 of 7177 tons. The tonnage launched in the other British Dominions was 51,255 tons and includes 31,453 tons launched in the Hong Kong district, and 17,408 tons in Australia. The totals for Hong Kong comprise 4 vessels of between 5000 and 6000 tons each.

SPAIN.

During the year 47,256 tons were launched in Spain. The figures include 2 steamers of about 5000 tons each, and 2 turbine vessels, 1 of 7000 and the other of 10,137 tons.

PROGRESS OF SHIPBUILDING ABROAD DURING THE YEAR.

Dealing with the combined totals for the work in hand in countries abroad, a steady decrease took place during the whole of 1921. At the beginning of the year the tonnage under construction amounted to 3,470,862 tons, while at the end of December the total was 1,816,774 tons, a decrease of 1,654,088 tons. Most of this reduction was due to the decrease in the shipbuilding industry in the following countries:—The United States (where at the end of December, 1920, there were 1,310,312 tons under construction, whereas the figures for December, 1921, were 216,428 tons) with a reduction of 1,093,884 tons; Holland with a decrease of 137,085 tons; the British Dominions 120,186 tons, and Japan 103,601 tons. The only shipbuilding country in which the tonnage under construction at the end of 1921 appears from the figures to have been considerably larger than that for December, 1920, is Italy, with an increase of about 30,000 tons.

The countries abroad having the largest amount of tonnage under construction at the end of 1921 were:—Italy, 393,832 tons; France, 352,635 tons; Holland, 313,879 tons; United States of America, 216,428 tons, and Japan, 144,912 tons. It should, however, be stated that the figures referring to work in hand at the end of December, 1921, included a considerable proportion (over 22 per cent of the total) of tonnage on which all work is now suspended, notably in Italy and the United States. The present condition, and the immediate future of the shipbuilding industry cannot therefore be correctly gauged from the totals of work in hand unless that factor, and others already mentioned when dealing with the United Kingdom output, are taken into consideration.

SUMMARY OF WORLD'S OUTPUT.

The world's total output during 1921 reached 4,341,679 tons. This figure represents a decrease of 1,520,000 tons as compared with 1920, but still exceeds by more than 1,000,000 tons that for 1913, during which year the pre-war world's record output was reached. The United Kingdom's percentage of the world's output during 1921 was practically the same as in the previous year, viz.:—35 per cent., but is considerably less than in 1913, when a figure of 58 per cent. was reached. A striking fact is that during the year under review there were launched 167 vessels of about 1,195,000 tons which will be fitted with steam turbines. This tonnage represents over 30 per cent. of the total world's output of steel steam tonnage, and gives an average tonnage of 7155 tons per vessel. The tonnage of now vessels which are being fitted with internal combustion engines is steadily increasing. During 1919 such tonnage amounted to about 156,000 tons, while for the year under review about 306,000 tons were launched; this total, however, only equals about 7¼ per cent. of the world's output of steam tonnage for the year.

Attention may be drawn to the diagram which indicates quite clearly the enormous increase in the tonnage launched during the last four years, as compared with pre-war periods. It may be stated that during these four years the total addition to the world's merchant navies by new construction amounted to nearly 23,000,000 tons, a total considerably higher than the combined output for the nine years 1905–1913.

VESSELS CLASSED BY LLOYD'S REGISTER.

Of the merchant vessels launched during 1921, 592 of 2,538,680 tons (331 vessels of 1,260,999 tons in the United Kingdom and 261 of 1,277,681 tons abroad) were built under the survey of the Society with a view to classification in Lloyd's Register book. These figures include 82 per cent. of the total output of the United Kingdom. Of the world output of steel steamers and motors of 1000 tons and upwards, over 60 per cent. are to be classed with Lloyd's Register. This latter percentage is in almost precise accordance with the average of the total figures for the last fifteen years, during which 29,400,000 tons of vessels launched were intended for the Society's classification, as will be seen from the smaller inset diagram. The total figures for 1921, following the general reduction which has taken place in the world's output, were lower than those for 1920, but still exceed by 468,265 tons the pre-war record total attained in 1913.

Electrification of Industrial Plant Railways.

IN a paper read before the Philadelphia Chapter of the American Society of Iron and Steel Electrical Engineers, Mr. D. M. Petty, electrical engineer, of the Bethlehem Steel Company, said that in many industrial plants the congestion of the yards and the character of the work to be performed was such that no type of current collecting system could be applied satisfactorily. At the same time, the weight and power required for the locomotive were such as to render difficult the use of a storage battery engine. A combination of the two systems immediately suggested itself. In the highly congested parts of the yard, where points were numerous and where the lines entered the buildings, the locomotive used its batteries. But in the less congested portions, where heavier trains were likely to be handled and steeper gradients were encountered, the engine took current from a trolley wire, a third rail or a contact system.

This plan had been tried with some success in the mining industry, the locomotive operating on a battery while gathering trucks in the short entries and using a trolley wire when pulling the loaded trucks on the main haulage line. In these cases it had been common practice to arrange the battery so that it was charged when current was being taken from the trolley wire, but a difficulty was presented by the variations in live voltage of the trolley wire, causing the battery to take very high current at times, while at other times the current was barely sufficient to keep the battery charged; or it fell so low that the battery discharged into the line. This difficulty had been overcome on some of the industrial plant railways by using a battery of considerably higher voltage than the trolley line voltage, so that it would not take any great amount of charging current while the locomotive was drawing current from the wire. At intervals, once a day or once in two or three days, the locomotive was out of service long enough to have the batteries charged in the usual way. This arrangement not only conduced to long life of the batteries, but also required a battery of small capacity as compared with that which would be required if the engine operated entirely on storage.

In congested parts of the plant railway, the movements were short and made at lower speeds than on the main lines. When the engine was working in this way the motors could be connected in series, thus reducing the current drawn from the batteries to about half of that which would be taken if the motors were operated in parallel. At the same time, the locomotive exercised practically the same drawbar pull in starting and at any speed up to half full speed as with the motors operating in parallel. Furthermore, this arrangement in itself made it possible to use smaller batteries.

A LARGE factory for the production of chemicals has just been constructed at Haiphong, French Indo-China, by the Société Industrielle de Chimie d'Extreme Orient. The first products that will be manufactured will be caustic soda, chlorine, oxygen and chloride of lime. It is expected that 3 tons of soda will be made daily by the electrolytic process.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

More Furnaces Going In.

AT all risks I am going to "speak" better things this week of the Midland iron trade. Let it be understood at once that I am not shouting. Conditions are still much too unsatisfactory successfully to tempt me to do that. There are still lots of unemployed plant, and that that is running is only partially employed. The reports, too, brought to Birmingham Exchange by the finished iron-makers are for the major part unsatisfactory, orders being spoken of as small and as arriving in only indifferent numbers. All the same, I can discover unmistakable signs of revival in the raw iron trade, and while I can do this I refuse to pose as a pessimist. It is the improvement in pig iron which encourages me to pronounce this week that trade is better. There is an increase in the number of Midland blast-furnaces that will soon be in operation. Last week I noted a fourth furnace as almost ready for re-lighting at the big works of Alfred Hickman, Limited, Spring Vale, Bilston. This week I can add another furnace as nearly ready for going in in South Staffordshire. Developments in the same direction are contemplated in North Staffordshire, and in the Northampton district three additional furnaces are being commissioned. All this looks decidedly more healthy, and I firmly believe we shall see a continuance of increased life amongst the blast-furnace people. To come to details. After a long interval another furnace is to be started in this district on high-class foundry iron. The owners are Messrs. G. and R. Thomas, of the Hatherton Furnaces, Bloxwich. The firm owns two furnaces, its speciality being iron for chilling purposes and cylinder manufacture, and one of these is to be started the first week in February. Respecting the North Staffordshire revival, I shall hope to be in a position to give some particulars shortly. Regarding the Northampton district, it is an established fact that new furnaces are to be blown in at Irodingham, Kettering, and Wellingborough.

Spring Prospects in Raw Iron Trade.

It is a fair inference from the re-starting of the foregoing additional furnace plant that smelters are looking forward to a spring trade revival. I adduced figures last week evidencing that lately consumers of pig iron have shown a little more confidence by increasing the tonnage of their orders. Here and there buyers who have abstained for months past are now placing orders on a cautious basis, in the belief that this can safely be done without risk of loss through further serious price reduction. It is well known that previously consumers have cut down their purchases strictly to the dimensions of current requirements. Now they must needs enter the market for quick supplies should orders for finished iron and for foundry products show any revival. Smelters are nervous about putting into stock, but if they are to sell it in the prevailing condition of the market they must keep on shading their prices a little. For the present pig iron is still being sold at a loss. It is notorious that prices leave no margin of profit, and in many cases involve a loss variously estimated from 2s. 6d. to 7s. 6d. per ton. Some houses this week are quoting 90s. for Derbyshire No. 3, but others are willing to entertain business at 85s. Northampton foundry iron has seen a further drop, 82s. 6d. and even 80s. at furnaces being accepted. General market rates on Birmingham Exchange, as I write, are:—Northamptonshire forge, 75s.; foundry, 82s. 6d. mean; Derbyshire forge, 77s. 6d.; No. 3 foundry, 87s. 6d. mean at furnaces. Midland makers like those in the North of England are counting to some extent upon a spring trade revival arising out of the displacement of continental supplies by home iron, now rendered possible by the reductions which our own makers have made.

Drop in Steel Sections Imminent.

Competition is still impairing the official prices of rolled steel plates and sections, and an official drop by the All-England Associated Makers is spoken of as imminent. The Scotch makers in particular continue to cut prices to such an extent as to leave the other steel-making districts of the kingdom scarcely a living wage. Happily, billets are a little steadier this week after the instability of last week. The minimum quotation is now £7 10s., and prices range up to £8. American quotations for billets have again been received this week, but at prices so much above the English quotation that business on these lines is quite out of the question.

European Steel Competition Beaten.

It is becoming most satisfactorily increasingly evident that European steel competition has mostly ceased to be troublesome. Possibly a few scattered deliveries are still being made on old contracts. But the latest quotations offer no advantage. On the other hand, a Birmingham merchant, as I intimated last week, has been applied to for a large consignment of British billets. It was wanted to complete a Belgian order for foreign delivery, which the continental steel works could not execute in the specified time. The business, however, did not materialise owing to the comparatively high cost of shipping the material from the British port to Antwerp. The shipping companies convey material to this country at half the price charged for shipment to the Continent. A peculiar situation exists to-day in South Staffordshire regarding the using up of steel billets and sheet bars in the iron mills. Steel re-rolling has become unprofitable. For the past six months the South Staffordshire ironworks have been utilising their idle plant in the re-rolling of steel billets, chiefly of foreign origin. The large steel works would not then look at the prevailing prices, and for a time the local ironmasters executed nearly all the finished bar business of the country. It is a somewhat remarkable circumstance that the large steel works producing from raw material have now recaptured this business, at prices quite unattractive to re-rollers.

Staffordshire Finished Iron Conditions.

It is, I regret, impossible to discover any relaxation of the competition in the Staffordshire finished iron trade. Lancashire mills are meeting the South Staffordshire makers on the new price level of £11 10s. delivered for nut and bolt and fencing qualities. A few orders are in view, but not sufficient in themselves to make big sacrifices worth while. If orders can be secured at something less than £11 10s. they will be taken. Meanwhile the organised Makers' Association sticks to the basis of £16 for marked bars, £13 for unmarked bars, and £13 10s. for iron strip. Some millowners are reported to be willing to cut the latter price, but the business obtainable in face of the competition of steel strip at £10 10s. is negligible.

Birmingham Engineers' Dinner.

The Birmingham Association of Mechanical Engineers held its thirty-first annual dinner on Saturday last, and some interesting speeches followed. The importance of mechanical engineering in the industry of this country can scarcely be over-estimated. We know the valuable work engineers played in the prosecution of the Great War, and it is equally certain that in times of peace they have a great *rôle* to fill. There were references to this subject, and attention was directed to the need for practical and commercial training, so that the problems relative to industry may be solved by those most intimately identified with it. In this respect the Birmingham Association and kindred organisations are contributing in no small degree by creating a good feeling among engineers by exchanging opinions on trade and technical topics, and by assisting scientific research. It is to be regretted that in the Birmingham Association there are only about 450 members, and hopes were expressed that the membership would at least be doubled. All hands should be joined in this great work of advancement. Sir Harris Spencer said that the Association had done magnificent work. He asked them to help to train commercial engineers. He believed in practical training, and he believed in the commercial engineer, whom he considered one of the greatest powers in the whole of our business life. The industry, he added, had got the improvements and the brains and the productive capacity, but somehow or other, as between employer and employed, they had not yet arrived at that broad view of things which would bring down the cost of production and help them in the markets of the world. At the present time that was one of the most important things they had to deal with.

Big Scheme of Mines Drainage for South Staffordshire.

The coal mines in the Old Hill area of South Staffordshire are to be given a new lease of life, and vast quantities of coal which, it was thought at one time, were lost to the country are to be saved. This satisfactory result is to be brought about by the institution of a new drainage scheme which the Ministry of Mines has this week approved. The scheme involves the formation of a new Drainage Board and includes the draining of three mines which were closed in consequence of flooding during the coal stoppage. Additional machinery is to be laid down, costing £40,000, the money for which will be raised by the local coalowners. It is hoped to drain off water under which millions of tons of coal at present lie buried. The water in the mines of the Old Hill area has been a source of trouble to the owners for many years, and with the old inadequate machinery it was found almost impossible to cope with the inrush. Even with the pumps at full pressure only the higher workings could be kept clear. The coal stoppage was the climax, for the water rose to such a height as to be halfway up the shafts when the dispute ended. After unsuccessful pumping efforts three of the most valuable mines had to be abandoned. The new scheme is a comprehensive one and is largely formed on the recommendations made by the Government Committee, which held an inquiry relative to the flooding of the South Staffordshire and East Worcestershire area. I understand that it is provided that there shall be a new area, which will include not only the Old Hill district, but also the adjoining parts of Dudley, Halesowen, Cradley, and Lyde Green. The addition of these new areas brings in districts which have not previously borne any of the drainage charges.

Coalowner Optimists.

The speeches of the coalowners at the annual dinner in connection with the South Staffordshire Mining Students' Association on the 28th ult. showed that those interested in coal mining in South Staffordshire took a very optimistic view of the future. Mr. J. C. Forrest—Cannock Chase Coalowners' Association—said that some of them had not expected to appear again at functions of that kind. If the country had decided that the coalowners should go they would have accepted the decision and would have cleared out. Experience, however, had proved that the country was sound at heart, and it spoke volumes for the confidence that some of them had in the future when he told those present that Colonel Harrison, chairman of the Cannock Chase Coalowners, and Mr. Cyril Lloyd, Dudley, were investing thousands of pounds in mining developments in South Staffordshire. Major Selby Gardner, secretary of the Cannock Chase Coalowners' Association, spoke of the Welfare Fund under the Coal Mines Act, and said that in the Cannock Chase district the amount to be raised would probably be about £20,000 per annum. There was every reason to anticipate that the amenities of the mining areas would be greatly improved by means of this money.

Bonuses Merged in Birmingham Brass Trade.

A new wages arrangement has come into force in the brass trades of the Birmingham and Wolverhampton district. An agreement has been arrived at between the manufacturers and the unions to merge the Churchill bonuses in a common standard of 29s. 4½d. above the base rates for all men over twenty-one. This amount represents the 92 per cent. by which the cost of living exceeds the pre-war level. Under the sliding scale adopted in the brass industry of this district wages fall by ½d. per hour for every fall of 6½ points in the cost of living.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron, Steel, and Metals.

THE feeling in the iron and metal markets is a little better this week, but so far as one can see there is not much, if any, improvement in actual business to account for it. It is probably the fact that we are slowly struggling towards better times, and in the iron trade at least there is more stability in the prices. This fact does not necessarily mean that the fall in prices is permanently over, but there seems to be a temporary check and some little chance of an improvement in consumption. The period of acute competition from the Continent is probably nearing its end, but there are signs of an American competition which may be quite as serious. The American attack on the iron and steel trade of the world has been delayed for a long time, but when it comes it may prove very awkward for British manufacturers in this department. The engineering trade, however, is merely concerned with obtaining cheap material from whatever source it may be offered.

Metals.

The market for the non-ferrous metals is duller than ever, and there is no sign of any improvement yet in copper prices. Standard copper reached another low price at the end of last week, but the relation between standard and refined copper is rather more reasonable than it has been. Best select ingot is, however, much too close in price to standard to enable anyone to believe that there is much improvement in the demand from consumers. There is still a better demand on the Continent and in America than there is in this country; but this may, and probably does, mean that American and continental engineers are getting a larger share of the world's trade in mechanical engineering. There is very little change to note in the prices current for old copper and metal. These prices are still much lower than they should be if there were any effective demand, and so long as dealers show no desire to buy this scrap at not much more than half its intrinsic value, we need not anticipate any sharp revival of new copper prices. American producers of copper are beginning to increase the output, and they seem to be anxious that all the world should be aware of the fact. One would like to know why this abandonment of the usual reticence has taken place. It is, of course, possible that the increase of output is not in anticipation of a growing consumption, but simply results from the fact that producers are tired of idleness, and prefer to risk production at a loss. The market for tin has been weak again, and it is perhaps time to expect a small reaction, but one does not see how, in the present state of the demand, the prices can advance very much. There may be some speculative covering sufficient to check the downward tendency. The large sales by the East are attributed to liquidation in view of the Chinese New Year, which dates from January 28th. If this be correct, then we may perhaps expect to see a reduction of sales from the East during the present week. The Federated Malay States Government is still holding large stocks of dear tin, and still protesting that it means to hold until the metal can be sold at a profit. One does not know exactly at what figure this metal stands in the Government books, but that there will be any chance of selling it at a profit within the next few years one does not believe. The position in the lead market does not show much change, and the feeling is still that we are nearer to a lower level of prices. There is an ample supply of the metal at present, and while the American exchange keeps up or goes still farther in our favour, there seems no reason why these supplies should become inadequate. Spelter has been rather weak, but there has been no very definite change up to the time of writing.

Foundry Iron.

The market here for foundry iron is still in a very poor condition, in spite of the fact that farther falls in the price are not immediately expected. The Manchester price for ordinary No. 3 pig is settled for a time at from 97s. 6d. to 100s. per ton, but consumers have as yet no great confidence in it. They know, of course, that the costs of production are slowly falling, and may perhaps look for some concessions in consequence; but makers of pig iron in the Midlands claim that the present selling prices leave them a loss, and hence that any economy in producing costs ought to go towards lessening that loss and not towards lessening the price. One favourable feature in the pig iron trade is that the export business has been recommenced; but it would perhaps be a mistake to suppose that that fact will have a stimulating effect on prices until all the idle blast-furnaces are again in operation. Consumers here continue to buy very sparingly, and the Midland furnaces cannot get large orders for forward delivery. Some of the Lincolnshire furnaces are still waiting for this class of business in order to blow in. Forge pig iron is very much neglected at present, and it is doubtful whether more than 80s. per ton at the furnaces can be obtained for it. On the other hand, hematite iron seems to be a little better.

Finished Material.

The prices for sectional steel remain irregular, but apparently, if anyone wants to know the dearest place in which to buy he should come to the Midlands. In Manchester there is only a poor demand, and recently the London merchants do not seem to have been getting on very fast. The continental prices for export make it very difficult for British makers to obtain Eastern orders, and when they are obtained they are taken at prices far below those quoted for the home trade.

Scrap.

There is no business worth speaking of in steel or wrought iron scrap, but a small amount is still going on in cast iron scrap, and dealers are fairly steady in their prices. For choice lots of broken "textile" castings £5 per ton is asked, and for other cast scrap from 85s. to 95s. per ton according to quality. There is, of course, only a small demand because many of the iron foundries of the district are short of work.

Wages Alterations—A Wise Decision.

At a meeting held in Manchester last week of the Legislative Council of the United Textile Workers' Association, which embraces representatives of all the operatives' trade unions in the spinning and manufacturing sections of the Lancashire textile industry, it was decided to accept the employers' proposal to vary the existing wages agreement by substituting one month's notice of any desired alteration in the cotton agreement in place of three months as heretofore. In their letter to the operatives' associations the employers pointed out that if the three months' notice were adhered to at the present time it would lead to merchants "withholding the placing of any business which was not urgent during the currency of the notice or until a new wages settlement had been arrived at," and that this, "besides being harmful to the employers, would mean more unemployment for the workpeople." Engineers will agree generally that the decision to make this change is a very wise one, and one which should be very carefully borne in mind when any negotiations of a similar character take place in the engineering industry. One of the causes of the present deplorable state of this industry is due to the withholding of orders by buyers pending long drawn out wages alterations.

Health of the Working Classes.

An address was given last week at the Manchester Y.M.C.A. by Dr. W. F. Dearden, medical officer to the Port Sanitary Authority, on the health problems of modern industry. He said that the excessive amount of disability and loss of life amongst those engaged in industrial occupations was appalling, and remarked that in this country there was no factory medical department, and that up to quite recently all the official medical work had been carried out by three medical inspectors connected with the Factory Department of the Home Office. The full number was now five compared with ten in Belgium. These doctors could not direct the necessary treatment; they could only recommend it. If the doctor was to have some real control over what curative measures were to be prescribed, a Factory Medical Department must be created, and, as in Belgium, placed under the control of a medical chief, who should be made responsible to a Minister of State. His staff should be adequate for the task of dealing with all unhealthy conditions in industry, and should include at least one medical inspector to be attached to each superintending inspector's district.

German Competition in the Iron and Steel Trades.

Speaking a few days ago to the colliery workers at Abram, Wigan, on the future of British trade, Sir W. Peter Rylands, chairman of the Pearson and Knowles Coal and Iron Company, said that German manufacturers had been offering their iron and steel commodities at £4 and £5 per ton less than British prices, and German workmen had been employed at a wage rate that compared with £1 or less a week with English rates. It was impossible that this country could compete with such prices, or that we could ask our workmen to accept the German standard of pay. He believed that the German policy was wrong, and unsound, and must ultimately result in financial trouble. When that time came, or as it approached, we might hope that the conditions under which competition had proceeded would change. When competition diminished Germany's difficulties would grow, because it would be impossible for her to make things as cheaply as she had been doing before. There was, he said, an indication already in certain lines in the steel trade that the competition was relaxing, and he was beginning to feel that in a few months' time there might be some little improvement in the trade of this country. It could not be rapid until Germany's wages rates were restored to what they were formerly.

BARROW-IN-FURNESS, Thursday.

Hematites.

There are no new features to report this week in connection with the hematite pig iron trade of this district. The demand for iron continues to be very quiet, and improvement is slow in manifesting itself. So far as Barrow is concerned, a fair tonnage of iron is going into prompt use in the neighbouring steel works, but in the Workington district steelmakers' requirements on local account have been nil for some time now. Buyers on general account are not inclined to place orders for more than what will fulfil their immediate wants. Orders are only moderately held just now.

Iron Ore.

There is rather less activity in some of the mines in the North Lancashire district, particularly those of the Barrow Hematite Steel Company. Across the border in Cumberland the Hodbarrow mines are still idle. The demand for iron is naturally limited, for business is still confined to local smelters, and they have only a few furnaces in blast. The importations of Spanish ore have been small for some weeks now.

Steel.

The steel trade at Barrow continues to be fairly well employed. Rails are occupying most of the attention in the big works, and hoops are being rolled in the smaller works from French billets, a further supply of that material having just arrived from Caen. Steel sections generally are in poor demand, and there is not much on offer in steel shipbuilding castings.

Shipbuilding and Engineering.

These trades are very quietly employed. Vickers Limited have completed the fitting out of the Commonwealth steamer Hobson's Bay, and she left Barrow this week to undergo her sea and other trials. She is set down to make her first trip out from London on February 28th.

SHEFFIELD.

(From our own Correspondent.)

The Tardy Revival.

So far as the heavy steel and engineering trades of Sheffield are concerned the revival is proving a very tardy affair, and only an occasional order of any appreciable dimensions—such as those I mentioned last week—relieve the prevailing gloom. Even the enthusiasm excited by the three-quarters-of-a-million order in connection with the electrification of South African railways very soon abated, when, on reflection, its was realised that this electrical work would provide employment for only a few hundred of the many thousands who are idle; indeed, it will scarcely touch the latter, for the electrical trade has been the least affected of any, and for the most part this Metropolitan-Vickers order will merely provide fuller employment for those engaged in this trade, and incidentally call for a few hundred tons of steel for the frames and casings of the electrical machines—a drop in the bucket in relation to Sheffield's normal output of steel. Even the order for 15,000 tons of rails shared between Messrs. Cammell Laird and Co. and the United Steel Company would not in normal times be regarded as anything out of the ordinary. These orders are, however, helpful, but what is wanted is some big development scheme, either at home or in the overseas dominions, and at present there are no signs of any such scheme materialising. Mr. Arthur Neal, Parliamentary Secretary to the Ministry of Transport, addressing his Sheffield constituents during the week-end, said that some of the South Country railway companies were submitting electrification schemes. But, then, Mr. Neal tells his constituents that at almost every visit—he said precisely the same thing many months ago, to my knowledge, so that his promises of prosperity for local industry in this connection have lost their first freshness. As a matter of fact, local manufacturers are far more hopeful of overseas developments. Only comparatively small orders or inquiries are coming in from the British railway companies, and it is evident that it is not the intention of the boards to spend any considerable proportion of the compensation money recently awarded by the Government on repairs and renewals; only the most urgent of these are being carried out. Nor are the tramways undertakings of the country showing any present disposition to place any considerable bulk of orders here. The Sheffield Corporation is setting an example in this respect, two extensions to outlying suburbs having just been put in hand, as part of a million pounds scheme, though the present instalments represent an expenditure of only about £50,000. All the rails are being rolled in Sheffield district. Transport development in another direction has also provided a welcome bit of work, Shell-Mex, Limited, having just opened a new bulk filling depôt, which is equipped for sending out nearly 10,000 gallons of spirit per day. The spirit is brought from the company's railway siding by a pipe line half a mile in length, and it is then stored in tanks having a total capacity of approximately 47,000 gallons. The battery of automatic filiers is capable of filling 4800 two-gallon tanks per day. From this centre a district extending over a radius of something like 15 to 20 miles will be served. This depôt is one of the largest in England.

Blast-furnaces' Brief Run.

There is a somewhat curious position as regards the blast-furnaces which have recently been re-started. While on the one hand it is a satisfactory sign that there are more in blast to-day than was the case a month ago, and that that number in turn was a distinct advance upon the previous month's figure, there is already talk of "setting down" some of these recently re-started furnaces, as they have apparently overstocked the market with their product. The cost and trouble of re-starting the blast-furnaces are so considerable that they are not allowed to become idle except under extreme necessity; but so small is the demand for iron and steel that in two or three cases firms are, I am assured, seriously contemplating another stoppage. Of course, some of the furnaces attached to the steel works are continuing in blast in order to supply the slightly increased demand occasioned by the few orders that are being booked on behalf of customers who are in this way meeting their day-to-day requirements. But none are looking far ahead; the whole trade is still carrying on in this precarious hand-to-mouth manner. Competition for the few orders for steel that are going is so keen that it is certain many are booked at unremunerative prices. Firms are hoping, however, that costs may decline sufficiently to enable them to complete the contracts without serious loss. One helpful factor is the cheaper quotations for hematite pig iron, the latest offer for mixed numbers being £5 15s. delivered, as compared with £13 10s. at the beginning of last year, and £3 10s. in 1914.

Fuel Costs.

But fuel cost is still a very serious item, coal prices being, generally speaking, something like three times what they were in 1914. During the past week there has been very little change in the position so far as inland consumption of industrial fuels is concerned. The outlook, however, is decidedly brighter than for some time past, and it is expected that the placing of orders for various materials will result in some expansion of the inland trade. At the week-end, prices were tending to harden somewhat as an immediate consequence of this prospective demand. The small fuel market is, however, on the weak side, as a result of a small demand for coke-making purposes and the limited number of blast-furnaces in operation. There are large stocks at the pits, and in many cases price is a secondary consideration, the immediate need being to reduce the stocks. While on the subject of fuel it is perhaps of interest to note that the Sheffield Gas Company is coming in for a good deal of attention again in connection with its application for parliamentary powers which will very materialy modify the existing relation between the price of gas and the amount of dividend distribution. Manufacturers who are opposing this application complain that while steel makers have brought their prices down to within 50 per cent. of pre-war figures, yet gas remains at from three to four times its pre-war price, while the pressure has been considerably reduced. As a result more firms are resorting to other sources of power and heat.

The Silver and Cutlery Trades.

The position of the lighter trades of Sheffield has not materially changed during the past week, work being somewhat unevenly distributed, with the result that, while some firms are as busy as they have ever been at this time of the year, others find it difficult to provide employment for even three or four days a week. Mappin and Webb, who have for a long time past been badly cramped in their present shops in the centre of the city, are about to move into very much more commodious works half a mile away. The new establishment consist of an imposing range of factories and shops mostly constructed of concrete, and will constitute one of the largest factories in the country—perhaps in the world—devoted to the manufacture of silver and electro-plated goods and cutlery; needless to say, the equipment and plant are the most modern obtainable. The unabated demand for stainless steel cutlery and other household articles continues to tax the resources of most of the firms specialising in this class of goods. The price has hitherto prevented the popularising of the commodity to the extent of competing with ordinary table ware of the non-stainless variety, but if a local firm makes good its claim this handicap will be a thing of the past. For a couple of years past this firm has been experimenting with an entirely new composition, and it now claims to have reached perfection, and is about to manufacture all kinds of table ware, on mass production scale, with this new metal, which is said to possess non-rusting and stainless properties equal to those of stainless steel and to be saleable at about one-third the price of the latter.

NORTH OF ENGLAND.

(From our own Correspondent.)

Big Wage Cut in Iron and Steel Trade.

THE report of the accountants to the Board of Conciliation and Arbitration for the Manufactured Iron and Steel Trades of the North of England for the two months ended December 31st last shows a further big reduction in selling prices and wages. For the two months in question the average net selling price of manufactured iron and steel realised by the affiliated firms was £13 12s. 10.43d. On this figure the sliding scale gives a reduction of 20 per cent. on puddling and other forge and mill wages, this taking effect from January 30th. This announcement may be taken in relation to the general downward tendency of iron and steel prices and wages over the past year. On January 31st, 1921, the percentage of wages above the standard was 225. The corresponding figure for November 28th last was 87½. This additional decrease of 20 per cent. brings, therefore, the present figure to 67½ per cent. above the standard, and shows incidentally a decrease on the year, according to the sliding scale, of 157½ per cent. Wages are, of course, entirely regulated by the selling prices, and the following table shows the various adjustments which have been made each alternate month over the past year:—

1921.	Reduction, per cent.	Above standard, per cent.
January 31st	5	225
March 28th	25	200
May 30th	30	170
August 1st	47½	122½
September 26th	25	97½
November 28th	10	87½
1922.		
January 28th	20	67½

The return of the different classes of material sold, and the average net selling price of each, for the two months ending December 31st, 1921, records no business in rails or plates; 2146 tons of bars realised an average net selling price per ton of £13 12s. 11.98d., and 23 tons of angles £13 1s. 2.42d.

Cleveland Iron Trade.

A most interesting development in the Cleveland iron trade this week is the news that 2000 tons of No. 3 Cleveland foundry iron has been sold to Germany. The transaction has created a great deal of surprise in iron trade circles in view of the depreciation of the German mark, and the quite recent importation into the district of large quantities of foreign iron. It is interesting to note that before the war Germany was Cleveland's largest foreign buyer of pig iron. Although a few tons of iron have been sold to Germany from time to time since the Armistice, this is the first order of any volume that has been received since August, 1914. The general position of the Cleveland iron trade shows little change on the week, though the placing of the German order encourages the hope that an improved export trade is an immediate prospect. Still the demand is as yet quite limited, and the output of the twenty-seven blast-furnaces operating on the North-East Coast so fully meets the requirements that there is no present likelihood of more furnaces being blown in. Foreign iron is still competing with Cleveland in the Scottish market, and Derbyshire and Northamptonshire iron is so much cheaper than Cleveland, that the Midlands and Lancashire are practically closed markets to Cleveland makers. Price-cutting, however, has been carried as far as can be reasonably expected at present, and there is no expectation locally of any further reductions for some time to come. Prices remain unchanged, No. 1 and siliceous iron being 95s. No. 3 Cleveland, G.M.B., 90s.; No. 4 foundry, 87s. 6d.; No. 4 forge, 82s. 6d., and mottled and white iron, 80s. The last-named quotation is quite nominal. Makers would be glad to get rid of their stocks of this low-grade iron, and, a free market existing for these qualities, they are willing to cut the price.

Hematite Pig Iron.

Quite good business has been done in East Coast hematite pig iron. The relatively low price has attracted buyers from all parts, both at home and abroad. It is stated to be possible to buy mixed numbers at 92s. 6d. per ton, and No. 1 at 95s., although the general quotations are 2s. 6d. above these figures.

Iron-making Materials.

Business in foreign ore is very quiet indeed. Nobody is inclined to do forward business, sellers because of the uncertainty regarding freights, and buyers because they are apprehensive of further falls in iron prices. Many consumers are, therefore, working from hand to mouth in the matter of ore supplies, and simply come on to the market for an odd cargo. Best Rubio ore is quoted at 25s. 6d. per ton c.i.f. Coke makers assert that price-cutting has reached its limit, and that they are not prepared to go below 26s. 6d. per ton, which is the average figure for good blast-furnace coke delivered at the works.

Manufactured Iron and Steel.

The stagnation in the manufactured iron and steel trade still continues, and work at most of the North-East Coast establishments is intermittent. Apparently buyers are still holding off in the hope of further price reductions, but it appears to be a forlorn hope. At a meeting of the Board of Conciliation and Arbitration, Mr. E. J. George, of the Consett Iron Company, pointed out that most firms, if not all the firms, producing steel at the present time and rolling it were losing money heavily. Buyers would have to make up their minds to come along at to-day's prices. He was quite satisfied that prices could go down no further, and whether there was trade or no trade, prices would remain where they were. If consumers can be convinced that this is the actual position, trade should rapidly improve for there is a firm belief that many substantial orders are being held back.

The Coal Trade.

The Northern coal trade position remains very firm and rigid throughout. The collieries are without exception well sold up to the middle of February, and merchants generally are clamouring for their supplies, which, in a number of cases, are not forthcoming because of the temporary scarceness of supplies, and the almost insuperable difficulty of effecting prompt shipments. A controversy is raging among shipowners, exporters, and others regarding the inordinate delay in loadings, and the detention of steamers, with the inevitable consequence of incurring heavy demurrage charges, which position is not calculated to assist the coal trade, but rather creates fancy and altogether fictitious prices, and tends to drive prospective buyers away from the market. This is a serious question at a time when everything should be done to encourage trade. Business for the most part is confined to spot delivery, with full figures obtainable in every instance, but buyers will not close forward contracts at present values, preferring to take their chance of more favourable terms later. Most of the collieries and exporters report that there is a very satisfactory and improving volume of inquiry coming forward, and there are hopes of a gradually expanding trade when the market has reached the bottom and something like a stable range of prices is established. One of the outstanding features is the rapidly improving outlook for Durham coking coal. Several large contracts are reported, with forward deliveries at very cheap figures, and as a result some of the collieries are of the opinion that the merchants have oversold their market, and are now anxious to cover their commitments at once. There are also numerous inquiries from the Continent, chiefly from France, Italy and Belgium. These factors have occasioned a temporary stiffening of the market for that class of coal, which is now quoted up to 21s. for some brands, while the situation reacts in favour of the second gas sorts, which are also improving. The Northumberland steam coal trade is very active, but hardly any of the favoured classes of best screened are to be had direct, while in second hands supplies are limited. Second steams are also very firm for prompt, and all grades of steam smalls are steady. Bunkers are fairly active for steamers' use, but there is not much business for the coaling stations. Coke is, on the whole, a shade better for foundries, while for gas coke there is a satisfactory demand.

Coal Miners' Wages.

A further wage reduction is to be suffered by the Durham miners for the month of February, but consequent upon the minimum wage clause in the national settlement the fall will not be nearly so great as would have been the case had wages been governed by the ascertainment. The percentage on the basis wage for February, as shown by the ascertainment, is 72.16, as compared with 93.87 in January, a drop of 21.71, whereas the minimum percentage below which wages cannot fall during the period of settlement is 89, so that the actual reduction will be 4.87 from the January percentage. The situation is viewed with considerable alarm by the Durham County Mining Federation Board, particularly in view of the fact that the owners will be called upon to contribute in wages 16.84 more than the percentage shown in the ascertainment. According to the accountants' ascertainment, the percentage on the basis wages payable to the Northumberland miners in February will be 82.66 per cent., or 3.1 per cent. lower than in the past month. This works out at a reduction of about 2d. per shift in respect of the higher paid men, and about 1d. per shift to lower paid men. The wages in Northumberland are now within 2.66 per cent. of the minimum under the terms of the National Settlement, and 21.77 per cent. above the 1914 wages. Since the reopening of the mines in July last, after the national stoppage, wages of miners in the county have been about halved, those of the higher paid men having fallen from about 18s. 11d. per shift to 9s. 4d. per shift.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding Output.

THE launches from Clyde shipyards during the month of January amounted to ten vessels of 58,614 tons aggregate. These figures apparently constitute a record for the month in respect to tonnage, but it so happens that two new passenger steamers account for practically half of the tonnage total, the twin-screw steamer Bendigo, 13,100 tons, for the P. and O. Company, and the twin-screw geared turbine Athenia, 12,000 tons, for the Anchor-Donaldson line. Included in the other returns were the twin-screw geared turbine Matiana, 8970 tons, for the B.I.S.N. company; the oil tanker Santa Maria, 8500 tons, for the Union Oil Company, Los Angeles; the cargo steamer Skiensfjord, 5922 tons, for Den Norske Amerikalinje, Christiania; and the oil tanker British Industry, 4204 tons, for the British Tanker Company, London. Though the returns would seem to indicate a certain amount of prosperity, once again it must be said that the launching figures are totally misleading as an indication of prospects or of the present state of the industry. The berths are emptying rapidly, and practically nothing is arriving to take the places vacated. Of late there have been signs of an improvement, and if costs fall still further, as it is expected they will do, hopes of better times may be realised. The result of the negotiations respecting shipyard wages will have a considerable bearing on the future position.

New Contract for Greenock.

An order for a new vessel of 400ft. in length, 52ft. beam, and 32ft. in depth has just been placed with Scott's Shipbuilding and Engineering Company, Greenock, on behalf of Alfred Holt and Co., Liverpool. An outstanding feature of the new vessel will be the installation of Scott-Still engines. The engines will have a combined brake horse-power of 2500 under service conditions. Up to the present the largest Still engine constructed is of the slow-running marine service type, and was built for experimental purposes by Messrs. Scotts under licence from the Still Engine Company, London. This engine has been under test for about two years, and the engines now to be built will have all the latest improvements.

Pig Iron.

There is hardly any improvement noticeable in the pig iron trade. The markets are depressing, and though makers are evidently disposed to do all possible to meet consumers, buying continues on a very meagre scale. The tendency of prices continues downward, but buyers are not inclined to purchase for stock even at the low rates now current.

Steel and Iron.

There is still a feeling of hope in the steel and iron markets that a revival in business cannot be long delayed. The reopening of several steel works encourages this feeling. Prices, however, will require to fall still farther if a large measure of success is to be gained in open competition with home as well as overseas producers. In the meantime new specifications are almost as scarce as ever, and few makers can see more than a few days ahead. Steel plates are in poor demand, both for home and export, even though as low as £9 per ton has been quoted for the latter. Sheets, perhaps, show more signs of life, though up to the present makers have not advanced their position much. Inquiries for the Far East, Australia and South America have been larger of late, and the latter country is showing considerable interest in the galvanised variety. Australia is inquiring for bridge-building material. Bar iron makers are only obtaining an occasional order, and the work in progress is altogether inadequate to provide regular employment for the plants. Other branches are in a similar position, there being no sign of marked improvement in any direction so far.

Coal.

The situation in the Scotch coal trade has been somewhat better during the past week, though the home demand is yet of a very disappointing character. In Fifeshire and the Lothians, where the trade is largely of an export nature, the collieries have been comparatively busy, and the outlook is fair. In these districts round coal has been meeting with some business, while nuts of all sizes are well cleared. In the West of Scotland the meagre demand for industrial consumption is still severely felt, and even with an improved demand for house coal most descriptions of round fuel are lagging. For a few days shipping tonnage was difficult to secure, but the supply is now better, though freights are pretty firmly held. Aggregate shipments for the past week amounted to 182,601 tons against 195,885 tons in the preceding week, and 296,622 tons in the same week in 1913. Consumers evidently anticipate a farther drop in prices, but coal masters are not sanguine. The failure of the Scottish railway companies to fall into line with the railways across the border in the matter of carriage charges has been a great disappointment to the Scotch trade, and may have a detrimental effect on the export department in particular. Consequently with oncost charges and general expenses still at a comparatively high level, any farther substantial fall in prices does not appear likely at present.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

MATTERS are very quiet in the coal trade, and so far as one can see there is no great amount of perturbation or anxiety regarding the prospect of serious labour troubles arising, notwithstanding that it is within the knowledge of everyone that the conditions prevailing in the coalfield are far from satisfactory. Probably the view is held that the men have not the money and, consequently, are without the power to strike; but still the President of the South Wales Miners' Federation pursues his programme of issuing warnings. He says that these are not mere idle threats, and he knows that the Executive and the workmen as a body are prepared for action of an extreme character if no other remedy can be found. Such action, of course, means a fight. Mr. Hartshorn adds that there is a breaking point, and "they are getting nearer and nearer to it." So far, the coalowners as a body have not taken any notice of the threats of Mr. Hartshorn, but last week-end Mr. John Kane, the President of the National Association of Colliery Managers, took up the challenge, and, on behalf of the members of that organisation, repudiated and resented the wild charges made by Mr. Hartshorn, and described them as uncalled for and baseless. He states that Mr. Hartshorn is simply raising a smoke-screen to hide the responsibility of himself and the other miners' leaders, who, by supporting a policy of "ca' canny" and strikes over a period of years, have brought the industry to the verge of bankruptcy and lowered the standard of living for the workers. Mr. Kane described the action of the President of the Federation as a "wanton and deliberate attempt to create, spread and foster bitter feeling between the workmen and the officials of collieries and the generation of an explosive atmosphere."

Railway and Dock Charges.

The feeling continues very strong that the railway and dock companies are not playing their part in assisting the recovery of trade by failing to make more concessions in the rates chargeable, especially for coal. Mr. Evan Williams, the President of the Mining Association of Great Britain, speaking at Swansea on Saturday last, expressed the view that the companies seemed to be concerned almost entirely with the dividends to their shareholders and the wages of their men, and not with the effect which those rates were having on the prosperity of the country as a whole. They could only hope that by pressure from all industries they might be able to get something again from the high railway rates. As a matter of fact, it was at one time last week thought that so far as non-statutory charges are concerned, the position was less satisfactory than ever. On the strength of some accounts that had been received by one firm, the rumour got about that the dock companies had withdrawn the reductions which had been in operation from January 1st, as well as the concessions which were offered to come into force as from January 16th. This was officially denied by Mr. J. H. Vickery, the chairman of the Bristol Channel Dockowners' Association, who made it clear that only the concessions announced for January 16th were withdrawn, these being the modifications which the Traders' General Committee declined to accept as a final settlement of its claims. Since then it is very evident that the dockowners have thought better of their action, as the secretary of the Traders' General Committee has received a communication from Mr. Vickery stating that the Dockowners' Association had decided to put into operation as from February 1st the concessions in non-statutory charges which were previously offered from January 16th. Mr. Vickery also stated that the Dockowners' Association had further considered the subject of statutory charges, and was now engaged in getting out certain additional figures. The Association intends holding another meeting for the examination of the information, after which it is proposed to suggest an appointment with the general committee of traders' representatives. It certainly looks, from these facts, as if the dockowners are beginning to appreciate the force of the traders' demands.

Miners' Wages.

There is no prospect that the wages of the miners will be lifted above the present minimum rates during the month of February. This, at any rate, was the opinion held at a meeting of the Executive of the South Wales Miners' Federation in the early part of this week. The Executive was engaged for some time discussing the financial position of the industry. The auditors' report on the situation for the month of December, on which, of course, the rates for February will be based, was not in the possession of the Executive, but it appeared to be known that the results would not permit of any increase being made in the rate of wages, which are now down to 28 per cent. on the 1915 standard, which is the minimum fixed under the terms of the national agreement. The Executive appointed a small sub-committee, with whom the owners are to be asked to confer with a view to discussing the practicability of some steps being taken to bring about an improvement in the general conditions.

The Tin-plate Trade.

The workmen's side of the Joint Industrial Council of the Welsh plate and sheet trades of this district decided last week-end to give notice to terminate the sliding scale which has been in operation for the agreed twelve months, and which was subject to three months' notice as from February 1st. At the meeting which was held resolutions were passed pledging support to claims for improved conditions to the low-paid men under the sliding scale, and at a meeting to be shortly held in connection with the recent ascertainment of the price of bars a request is to be made that on top of the low percentage due under the sliding scale a substantial grant should be asked for. As regards the future of the industry, Mr. H. C. Bond, the deputy-chairman of Richard Thomas and Co., appears to be very optimistic. He says that the men are individually giving a much better output than during and immediately after the end of the war. The East and Canada are now among the industry's best overseas customers. For many years the Canadian trade was entirely in the hands of the United States, but latterly Welsh makers have been able to undercut the American prices. Australia and the Continent were at one time among their best customers. The former is showing slow signs of recovery, but it is not expected that Europe will come prominently into the reckoning until the financial conditions are more established. Once this stabilisation has been brought about, a really thriving time for the South Wales tin-plate industry generally is anticipated. Railway rates and harbour dues, however, form a serious obstacle to a quicker recovery of the trade.

Current Business.

The demand for South Wales steam coals has not improved during the past week, but despite the quietness which prevails shipments maintain a fairly good level. Large descriptions are relatively in less demand, but still there are signs that the policy of salesmen adhering to their prices and refusing to cut is proving successful, as, if anything, there appears to be a greater disposition to pay up on the part of buyers instead of postponing their purchases on the chance of prices falling further. Sized coals and smalls are very firm, and collieries are well booked up, particularly for nuts, beans and peas, for which very good prices are obtainable. Patent fuel and coke remain stationary in value, with the inquiry rather on the restricted side, while anthracite coals are easier, except in the case of nuts, which are still in good request and firm. Pit-wood is in slightly better demand, with prices about 29s. to 31s.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

Drop in Miners' Wages.

THE largest drop yet recorded in the wages of miners in this area under the monthly ascertainment was announced this week by the Wages Board of the colliery industry. The percentage addition to the standard wages for the month of February for the Eastern area, which includes amongst other districts Cannock Chase and Warwickshire, has been fixed at 97.06, or 12.8 less than in January. This means a reduction in wages ranging up to one shilling per shift; an even more drastic cut is anticipated in March.

WALES AND ADJOINING COUNTIES.

Swansea Metal Exchange.

BUSINESS is very quiet in the tin-plate trade. Orders are lacking, and prices are on the easy side. Some mills have already had to cease operations.

The Coal Industry.

The coalowners' representatives on the Conciliation Board have decided to agree to the proposal of the men's representatives for the appointment of a joint sub-committee, consisting of six members on each side, for the purpose of considering what action can be taken to secure an improvement in the position of the industry in this district. Arrangements are being made for an early meeting of this sub-committee, probably on Monday next.

New Steamship Line.

A new steamship line was inaugurated from Swansea on Tuesday last, namely, a service between Swansea and Chile. The trade in this direction was in previous years been carried on by sailing vessels. The first boat of the new line is the s.s. Pernico, a Chilian coasting mail boat, which has been loading 3000 to 4000 tons of coal and tin-plates for Valparaiso.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are informed that the Liverpool offices of the Automobile Association have been transferred to 35, Dale-street. Telephone number, 204 Bank, Liverpool. Telegrams, "Fanum, Liverpool."

WILLIAM JACKS AND CO. inform us that owing to the re-building of East India-avenue, in which their office was at No. 5, they have removed to Winchester House, Old Broad-street, London, E.C. 2. New telephone numbers: London Wall 7957, 7958, 7959.

WAILES DOVE BITUMASTIC, Limited, of Newcastle-on-Tyne, at its recent annual meeting, added to its board of directors Mr. Percy Hedley and Mr. Thomas Macdonald, son of Mr. Charles Macdonald, who has been associated with the company for many years past.

MR. ARTHUR J. CRIDGE asks us to state that he has resigned the position of manager of the Transformer Sales Department of Metropolitan-Vickers Electrical Company, Limited, in order to join the staff of the Brush Electrical Engineering Company, Limited, of Loughborough.

WE are asked to state that Mr. William Reah, assistant manager of Joseph Pugsley and Sons, Limited, Cattybrook Ironworks, Bristol, is resigning that position, and is joining M. B. Wild and Co., Limited, engineers, Nechells, Birmingham. He will take charge of the interests of the latter firm in the south-west of England, and will take up his residence in Cardiff early next month.

THE VISCO ENGINEERING COMPANY, Limited, 82, Victoria-street, London, S.W. 1, has appointed the following gentlemen as its sole representative for South Wales, Scotland, and the North-East Coast respectively: Mr. F. J. Rynd, Motor House Chambers, Wood-street, Cardiff; Mr. Charles J. Sellar, 144, St. Vincent-street, Glasgow; Mr. P. S. Thompson, Grafton Chambers, 99, Albert-road, Middlesbrough.

THE TIMBER FIREPROOFING COMPANY, Limited, has received intimation from the Board of Trade that it has instructed its surveyors at the various ports that doors constructed of wood treated by the "Oxylene" process so as to render it fireproof may be accepted as meeting the requirements of paragraph 29 of the Board's "Instructions relating to the Construction of Passenger Steamships," provided they are of approved construction.

CONTRACTS.—Hollings and Guest, Limited, have received orders for a horizontal four-throw chain-driven hydraulic pump from the Baroda State Railways for the purpose of working hydraulic presses in the Baroda workshops. The firm is also supplying a large hydraulic accumulator to work in conjunction with this plant. The East Indian Railways have recently also ordered from this firm a hydraulic briquetting press.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	37/-
(1) Spanish	28/-
(1) N. African	28/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	25/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) **SCOTLAND—**		
Hematite	5 10 0	—
No. 1 Foundry	5 10 0	—
No. 3 ,,	5 5 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 12 6	4 12 6
No. 1	4 15 0	4 15 0
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 2 6	4 2 6
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS.		
Staffs.—		
All-mine (Cold Blast)	11 10 0	—
Part Mine Forge	*None offering.*	
North Staffs. Foundry (*Nom.*)	5 0 0	—
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 5 0 to 4 7 6	
,, Forge	3 15 0	—
(3) Derbyshire—		
No. 3 Foundry	4 7 6 to 4 10 0	
Forge	3 17 6	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	6 5 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best ,,	17 0 0	—
N.E. COAST—		
Common Bars	12 10 0	—
Marked ,,	18 0 0	—
Tees	14 10 0	—
LANCS.—		
Crown Bars	13 0 0	—
Hoops	16 5 0	16 0 0
S. YORKS.—		
Crown Bars	13 0 0	—
Best ,,	14 0 0	—
Hoops	16 0 0	—
MIDLANDS—		
Marked Bars (Staffs.)	16 0 0	—
Crown Bars	12 0 0 to 13 0 0	
Nut and Bolt Bars	11 10 0 to 12 0 0	
Gas Tube Strip	13 0 0 to 13 10 0	
Hoops (*Nom.*)	16 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) **SCOTLAND—**		
Boiler Plates	14 0 0	—
Ship Plates ⅜in. and up	10 10 0	—
Sections	10 0 0	—
Steel Sheets ⅛in. to ⅜in.	12 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	16 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	16 0 0	—
Joists	10 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	9 10 0	—
Soft Billets	7 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 10 0	—
Boiler ,,	14 10 0	—
MANCHESTER (*Prices irregular and uncertain, unchanged*)—		
Bars (Round)	10 0 0 to 12 0 0	
,, (others)	11 0 0 to 12 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0 to 13 0 0	
Bessemer Billets	12 0 0	—
Hard Basic	10 0 0	—
Soft ,,	8 0 0 to 9 0 0	
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
MIDLANDS—		
Small Rolled Bars	10 0 0	—
Bessemer Billets	7 15 0 to 8 0 0	
Hoops	12 0 0 to 12 10 0	
Gas Tube Strip	10 10 0	—
Sheets (24 W.G.)	13 10 0 to 14 0 0	
Galv. Sheets (f.o.b. L'pool)	16 0 0 to 16 10 0	
Angles	9 10 0 to 10 0 0	
Joists	10 10 0	—
Tees	11 0 0	—
Bridge and Tank Plates	9 10 0 to 10 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/- to 19/6
Block Tin (cash)	159 10 0
,, (three months)	161 5 0
Copper (cash)	64 0 0
,, (three months)	64 15 0
Spanish Lead (cash)	22 15 0
,, (three months)	22 10 0
Spelter (cash)	25 0 0
,, (three months)	25 10 0
MANCHESTER—	
Copper, Best Selected Ingots	67 0 0
,, Electrolytic	71 10 0
,, Strong Sheets	96 0 0
,, Loco Tubes	0 1 2½
Brass Loco Tubes	0 1 0½
,, Condenser	0 1 3½
Lead, English	24 0 0
,, Foreign	23 0 0

(*Metal prices practically unchanged*).

FERRO ALLOYS,

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£26	10/-
,, 6 p.c. to 8 p.c. ,,	£25 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£24 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£75	26 6
,, 1 p.c. ,,	£91	31/-
,, 0·75 p.c. carbon	£110	37/6
,, carbon free	2/1 per lb.	
Metallic Chromium	5/1 per lb.	
Ferro Manganese	(per ton) £15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£21 10 0 scale 6/- per unit	
,, Vanadium	21/- per lb.	
,, Molybdenum	7/- per lb.	
,, Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£180	
Cobalt	14/- per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	22/-
,, ,, Ell	22/-
,, ,, Splint	23/6 to 26/3
,, ,, Trebles	25/-
,, ,, Doubles	23/-
,, ,, Singles	18/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	22/-
,, ,, Splint	23/6
,, ,, Trebles	25/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	20/- to 23/-
Screened Navigation	28/-
Trebles	26/-
Doubles	22/6
Singles	18/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	22/6
Secondary Steam	22/-
Trebles	26/-
Doubles	23/-
Singles	18/6

ENGLAND.

(3) **N.W. COAST—**	
Steams	33/-
Household	40/- to 55/-
Coke	32/6
NORTHUMBERLAND—	
Best Steams	23/6 to 24/6
Second Steams	21/6 to 22/-
Steam Smalls	13/6 to 14/-
Unscreened	21/6
Household	25/- to 30/-
DURHAM—	
Best Gas	21/6 to 22/-
Second	20/- to 21/-
Household	25/- to 30/-
Foundry Coke	32/- to 33/-
SHEFFIELD—	**INLAND.**
S. Yorks. Best Steam Hards	25/- to 26/- —
Derbyshire Hards	24/- to 25/- —
Seconds	23/- to 24/- —
Cobbles	23/- to 24/- —
Nuts	19/- to 20/- —
Washed Smalls	16/- to 17/- —
Best Hard Slacks	16/6 to 17/- —
Seconds ,,	13/- to 14/- —
Soft Nutty ,,	13/- to 13/6 —
Pea ,,	9/- to 11/- —
Small ,,	7/- to 8/- —
House, Branch	39/- to 40/- —
,, Best Silkstone	37/6 to 39/- —
Blast Furnace Coke (Inland and Export)	17/6 to 24/6

(9) SOUTH WALES.

CARDIFF— Steam Coals:	
Best Smokeless Large	24/6
Second ,, ,,	24/- to 24/6
Best Dry Large	24/- to 24/6
Ordinary Dry Large	23/6 to 24/-
Best Black Vein Large	23/- to 24/-
Western Valley ,,	22/6 to 23/-
Best Eastern Valley Large	22/6 to 23/-
Ordinary ,, ,,	21/6 to 22/6
Best Steam Smalls	18/- to 19/-
Ordinary ,,	12/6 to 17/6
Washed Nuts	27/6 to 32/6
No. 3 Rhondda Large	27/6 to 30/-
,, ,, Smalls	19/- to 20/-
No. 2 ,, Large	22/- to 23/-
,, ,, Through	19/- to 21/-
,, ,, Smalls	15/- to 16/-
Coke (export)	32/6 to 35/-
Patent Fuel	24/- to 27/-
Pitwood (ex ship)	30/- to 31/-
SWANSEA— Anthracite Coals:	
Best Large	50/- to 55/-
Seconds	45/- to 50/-
Red Vein	40/- to 45/-
Big Vein	50/- to 52/6
Machine-made Cobbles	72/6 to 75/-
Nuts	72/6 to 75/-
Beans	50/- to 55/-
Peas	18/- to 20/-
Breaker Duff	7/- to 7/6
Rubbly Culm	10/- to 11/-
Steam Coals:	
Large	22/6 to 25/-
Seconds	20/- to 22/6
Smalls	12/6 to 15/-
Cargo Through	18/6 to 20/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Price Cutting.

THE present economical conditions of Europe have so far facilitated price cutting on the part of countries with a depreciated exchange rate that efforts are being made by forgemasters in Britain, France, Belgium and Luxemburg to come to some arrangement for adjusting the exports of iron and steel and maintaining prices at a normal level on the international market. If countries like France and Belgium continue to offer large supplies at almost any price the situation is bound to become worse than it was during the period of German dumping before the war, and it was in the hope of avoiding a collapse that forge masters recently met in Paris to discuss the situation and see if something can be done in the way of an international agreement. The British wanted to bring Germany into the combination. This the French refused, and there appears, at any rate, little to be feared from Germany at the moment, since that country is unable to procure sufficient supplies of raw material to send heavy consignments of finished products abroad. All the allied countries are of the opinion that something must be done to stabilise the situation by putting a check on price cutting, but there are certain difficulties in the way, notably on the part of Belgium where some of the iron and steel firms are reluctant to submit to any restraint when competing for foreign business. Obviously, nothing can be done until each country has an organisation of its own, as is the case with Britain and France, and as soon as Belgium is able to come into line another conference will be held to settle the terms of an agreement.

Public Transport.

Since the Department of the Seine took over the motor omnibus and tramway services in Paris and the suburbs, and handed them over to the Société des Transports en Commun de la Région Parisienne, a considerable development has taken place in the transport facilities, and the policy of bringing all the services under one control is now likely to be extended to the suburban railways. These consist of an outer circle known as the Grande Banlieue, of which sections are owned by the different railway companies. They obviously come under the scheme for bringing the Paris and suburban transport arrangements up to date, and reorganising them under better and more economical conditions by one company, which is capable of adapting them to the growing requirements of local traffic, and the General Council of the Seine has therefore approved of the application of the Department of the Seine to obtain a concession of the Outer Circle, including the lines to Saint-Germain, Argenteuil and Maisons-Laffitte.

Paris Water Supply.

The scheme for bringing an additional supply of water to Paris from the sources of the Voulzie, Durteint and Dragon is to be carried out with the aid of funds raised by the last municipal loan. The technical services have presented a project on exactly the same lines as the existing works. They propose to construct a concrete conduit with eleven syphons for connecting up the three smaller conduits from the sources with the Loing aqueduct. An equal quantity of water will be returned to the rivers from the Seine by means of a pumping plant with a rapid filtering bed to be erected at Beaulieu. The second scheme presented by Pont-à-Mousson has been recommended for acceptance by the Commission on the ground that while costing four million francs more than the estimate of the municipal technical services it has yet the advantage of being carried out much more rapidly. The conduit will be of cast iron, and the water will be conveyed under pressure.

Havre-Paris Pipe Line.

The failure of the American contractors to carry out their undertaking to construct a pipe line from Havre to Paris for the transport of 3000 tons of oil daily does not imply that the scheme has been abandoned. It was stated some time ago even that a proposition had been received from a German group. It seems, however, fairly certain that the scheme will be carried out by the Compagnie Française des Transports de Mazouts et Pétroles, the project of which has been submitted to the Ministry of Public Works, and it is expected that the plans will be approved of soon enough to enable the company to start operations in the spring. Storage tanks are to be constructed at Havre and Paris having a total capacity of 60,000 tons.

Unemployment.

The question of unemployment is so far from causing trouble that in many industries there is an actual shortage of labour. Even at a time of industrial crisis the number of men out of work is not very great, the largest total in receipt of relief being 89,289 in the early part of last year. Since then the number has been steadily diminishing until last week it was no more than 9700. More than two-thirds of that number were in the Department of the Seine. The continual diminution of unemployed points to a gradual improvement in the industrial situation, and when business revives generally a more serious problem will be the finding of sufficient labour. There has always been a shortage more or less in France, and it was naturally aggravated by the results of the war, while the situation has been further complicated by the eight hours' day, which will have to be modified if the country's production is to be considerably increased.

Marseilles Exhibition.

Work is being pushed forward so rapidly with the laying out of the colonial exhibition which is to be held at Marseilles in April next that there is every prospect of its being more advanced on the opening day than is usually the case. The exhibition promises to be more than usually attractive on account of its characteristic architectural features, each colony having some notable building of its own. This will be the first great manifestation of the national interest being taken in colonial development, which is regarded as indispensable for the country's future prosperity.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

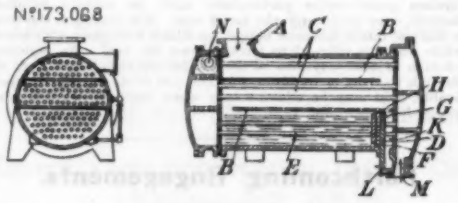
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

173,068. September 23rd, 1920.—IMPROVEMENTS IN AND RELATING TO FEED-WATER HEATERS, The British Thomson-Houston Company, 83, Cannon-street, E.C., and Frederick Samuelson, of "Holyrood," 44, Hillmorton-road, Rugby.

This invention relates to feed-water heating in connection with installations in which steam is tapped from the main turbine for the purpose of heating the condensate on its return to the boilers. The steam inlet is shown at A. At B there are horizontal division plates which direct the steam over the tubes C.

N°173,068



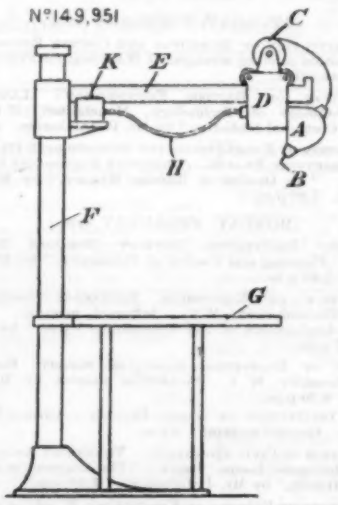
A weir D serves for banking the condensate and for submerging the tubes E. The condensate finally escapes through the orifices F and G, whilst the air and non-condensable vapours pass through the orifices H and G into the chamber K, where they are further cooled, and they finally pass through the discharge opening L to the condenser. The feed-water inlet is shown at M. The feed water makes several passes through the banks of tubes and then through the outlet N to the feed storage tank.—*December 23rd*, 1921.

ELECTRIC WELDING.

149,951. July 16th, 1920.—IMPROVEMENTS IN AND RELATING TO ELECTRIC ARC WELDING APPARATUS, Siemens Schuckertwerke G.m.b.H., of Siemensstadt, near Berlin.

This invention relates to a welding device of the type illustrated. A is the welding head and B the electrode, which consists of an iron wire which is mounted on the drum magazine C and is fed into the welding head by a feeding device which is not illustrated. The welding head is carried on a movable slide D,

N°149,951



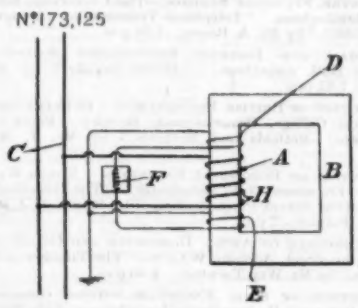
which is constructed in the form of an overhead crab. The slide D is mounted on a support E, which is mounted in turn on a pillar F, on which it can move in a vertical direction, whilst it can also be rocked thereon. The fixed work plate G is arranged underneath the welding head, and the feeding device for the welding material is driven by means of a flexible shaft H from a motor K.—*December 16th*, 1921.

SWITCHGEAR.

173,125. October 23rd, 1920.—IMPROVEMENTS IN AND RELATING TO MEANS FOR PROTECTING ALTERNATING CURRENT APPARATUS, Herbert Pearce, of 59, Hillmorton-road, Rugby.

In the drawing a coil of insulated wire A is mounted on a

N°173,125



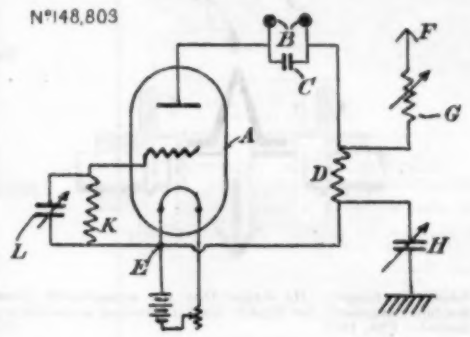
magnetic circuit B and connected to alternating-current supply mains C. Supplementary coils D and E are mounted symmetrically with respect to the coil A. These coils are connected in series through an automatic relay F. The connections are such that the electromotive forces set up in coils D and E will normally oppose each other. These coils are similar and are symmetrically placed so that under normal conditions no current will flow through the relay F. If, however, two or more turns become short-circuited at the point H, for example, of the main coil A, the distribution of the magnetic flux will no longer be symmetrical and the electromotive force generated in the coil D will no longer be equal to the electromotive force in the coil E, so that a current will flow through the relay F, which will operate the circuit breaker. If a second winding be placed on the core the arrangement will then represent a transformer.—*December 29th*, 1921.

WIRELESS TELEGRAPHY.

148,803. July 10th, 1920.—METHOD OF CONNECTION FOR PRODUCING OSCILLATIONS WITH VACUUM TUBES, Dr. Erick F. Huth G.m.b.H., of 130 and 132, Wilhelmstrasse, Berlin.

A is a vacuum tube of usual construction. A circuit is formed from the anode, through the battery B with a condenser C in parallel, and through a coil D, to the incandescent cathode at the point E. Coil D may, if desired, be variable. The antenna F is connected to the coil D through a variometer G, or it may be coupled inductively with it and may be also provided with a

N°148,803



condenser H. The grid is excited by a completely independent oscillation circuit consisting of coil K and condenser L. The wave length is determined by the adjustment of the grid oscillating circuit. The special feature of the invention is that there is no inductance or capacity coupling between the anode circuit and the oscillating grid system. It is possible to produce an almost unlimited range of wave lengths, and there is an entire absence of auxiliary oscillations.—*December 12th*, 1921.

148,955. July 10th, 1920.—IMPROVEMENTS IN WIRELESS TELEPHONY SYSTEMS, Société Française Radio-Electrique, of 79, Boulevard Haussmann, Paris.

The exciting winding A of a high-frequency alternator is fed by the telephone transformer B, the primary circuit of which contains the microphone. The exciting winding is in circuit with a transformer C which couples with the circuit the negative resistance of an arc D through a safety or stop condenser E. Owing to the inductance F, the current of the exciting winding is not shorted by the source which feeds the arc. A capacity G combines with the inductance of the exciting winding A to give a natural frequency equivalent to speech frequency, and

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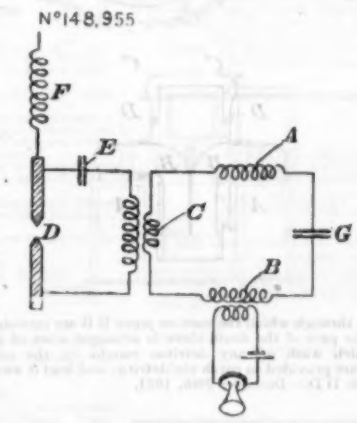

in view of this frequency being indeterminate it is evidently necessary to establish a resonant circuit responsive to frequencies varying over a wide range. It is evident that the telephone current may be amplified before its passage through the transformer B. The system is regulated in such a way that the ohmic resistance of the circuit is almost counterbalanced by the negative resistance introduced by the arc. Under these conditions with a suitable ratio of transformation of the transformer B, the excitation of the alternator may be controlled by the microphone. There are two other illustrations.—*December 12th*, 1921.

TRANSFORMERS.

173,062. September 21st, 1920.—IMPROVEMENTS IN AND RELATING TO OIL-IMMERSED TRANSFORMERS, The British Thomson-Houston Company, 83, Cannon-street, and Walter John Boddy, of "St. Andrews," Clifton-road, Rugby.

According to this invention, resistance grids A are placed

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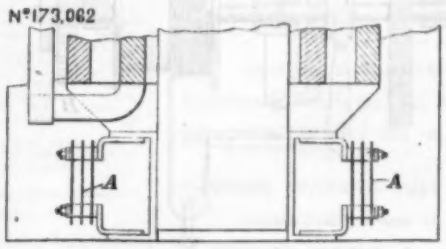


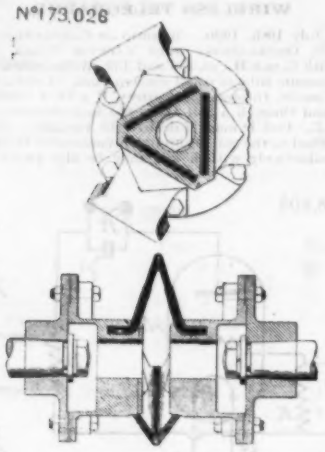
in the lower part of transformers for drying out the moisture from the windings and insulating oil. These grids or heating coils are connected either in series or in parallel with any low-

voltage system, or they may be connected to the low-tension side of the transformer winding, and the provision of the grids enables the transformer windings and the oil to be dried out after the transformer has been erected and before it is put into commercial operation.—*December 21st*, 1921.

TRANSMISSION OF POWER.

173,026. September 10th, 1920.—Flexible Couplings, R. Chilton, Keyport, New Jersey.

The inventor proposes to make a flexible coupling with laminated plates bent as shown in the drawing and cast into the

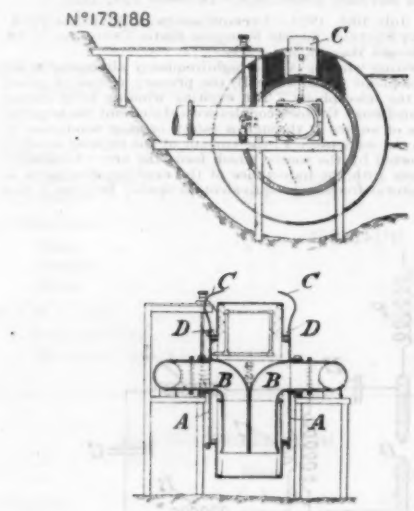


connecting flanges. He claims that the arrangement gives flexibility angularly, but rigidity against torsional movement.—*December 12th*, 1921.

WATER PURIFICATION.

173,186. October 8th, 1920.—Water Strainers, H. C. Anthony, 53, Osborne-road, Jesmond, Newcastle-on-Tyne.

This screen takes the shape of a drum and is perforated only on the vertical faces as shown. This drum revolves on fixed side

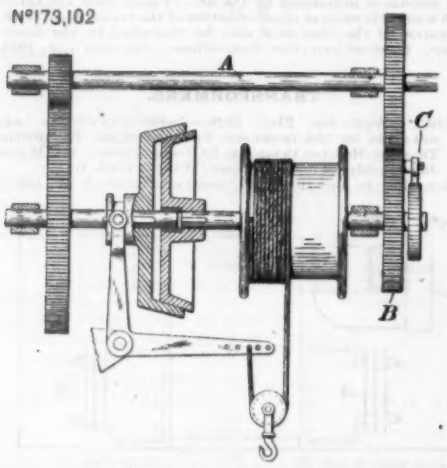


plates A A, through which the suction pipes B B are introduced. In the upper part of the drum there is arranged a set of water sprays, which wash off any detritus caught by the screen. Hoods C C are provided to catch the detritus and lead it away to the channels D D.—*December 29th*, 1921.

CRANES AND CONVEYORS.

173,102. October 11th, 1920.—Lowering Gear, W. W. Padfield, 2, Cedar Villas, Oldfield Park, Bath.

The inventor proposes to expedite the lowering of a load, as compared with its hoisting, by introducing a slipping clutch in



the train of gearing in the winch. The driving shaft is shown at A, and during hoisting it operates the barrel through the gearing on the left and the clutch, which is kept in engagement by the weight of the load. The gear wheel B of the train on the right is loose on the shaft of the barrel, but can drive it in the direction for lowering through the ratchet C. When hoisting this ratchet overruns. In order to lower the load the direction of rotation of the driving shaft A is reversed, and the motor, being assisted by the weight of the load, overcomes the friction of the clutch. The proportions of the gear wheels are such as to give a greater lowering than hoisting speed.—*December 29th*, 1921.

MISCELLANEOUS.

173,072. September 23rd, 1920.—Treatment of Coal, R. Lessing, Southampton House, 317, High Holborn, London.

In this specification the inventor says that he has found that by subjecting coal to the action of an acid agent the union between the several constituents of the coal is weakened so that mechanical separation of the constituents or aggregates of these is facilitated. It follows that by preliminary treatment with an acid agent the separation of the constituents of the coal by washing or other concentration process is improved. Secondly, the mining of coal may be facilitated by the action of an acid agent on the coal *in situ*. In this case also the agent acts to loosen the union between masses of coal, the first attack being at the comparatively extensive interface between the layers which occur in the seam or deposit; as the attack proceeds the acid agent permeates the coal to a greater extent. In treating mined coal it is generally convenient to pass acid gases—for instance, furnace gases—more particularly such as contain sulphur dioxide, over or through the moist coal. For example, the coal is charged into a tower or hopper up which acid gases are passed while water is allowed to trickle down the coal. An aqueous solution of acid may also be used either by trickling it over or through the coal or by immersing the coal in it. Or where practicable, acid may be added to the water used for washing the coal.—*December 23rd*, 1921.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Junior Institution of Engineers.—Caxton Hall, S.W. "Utilisation of Waste Heat from Internal Combustion Engines," by Major W. Gregson. (Lantern.) 8 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. Discourse: "The Mount Everest Expedition," by Lieut.-Colonel Sir Francis Younghusband. 9 p.m.

Institute of Cost and Works Accountants.—Gordon Salon, Holborn Restaurant, Holborn, W.C. 1. Costing Conference. "The Necessity for Scientific Costing." 2.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, S.W. Extra general meeting. Discussion on paper, "Some Observations on a Producer Gas Power Plant," by Mr. H. S. Denny and Mr. N. V. S. Knibbs. 6 p.m.

SATURDAY, FEBRUARY 4TH.

The Institution of Municipal and County Engineers.—The Institution meeting arranged at Wakefield for February 4th has been cancelled.

Institution of British Foundrymen: Lancashire Branch.—College of Technology, Manchester. "Foundry Accounts, Costs and Statistics," by Mr. R. Dunkerley. 4 p.m.

Association of Engineering and Shipbuilding Draughtsmen: Merseyside Branch.—University Engineering Building, Liverpool. "An Outline of Russian History," by Mr. C. C. Stevenson. 7.30 p.m.

MONDAY, FEBRUARY 6TH.

Bradford Engineering Society.—Bradford Technical College. "Planning and Control of Production," by Mr. R. O. Herford. 7.30 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment W.C. Informal meeting. "Some Practical Applications of the Thermionic Valve" by Mr. J. Joseph. 7 p.m.

Society of Engineers.—Geological Society, Burlington House, Piccadilly, W. 1. Presidential address, by Mr. T. J. Gueritte. 5.30 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly. General meeting. 5 p.m.

Institution of Civil Engineers: Yorkshire Association.—Hotel Metropole, Leeds. Paper: "The Engineer as a Factor in Public Health," by Mr. J. Johnstone. 7.30 p.m.

Institution of Electrical Engineers: Western Centre.—South Wales Institute of Engineers, Cardiff. Visit of president, Mr. J. S. Highfield. Annual dinner. 6.30 p.m.

Royal Institute of British Architects.—9, Conduit-street, W. 1. President's address to students. 8.30 p.m.

Petter Engineering Society.—Yeovil. Third and final lecture on Sir Henry Bessemer, by the President. 8 p.m.

Royal Society of Arts.—John-street, Adelphi. Cantor Lecture III.: "Inks," by Mr. C. A. Mitchell. 8 p.m.

TUESDAY, FEBRUARY 7TH.

Manchester Metallurgical Society.—College of Technology, Manchester. Paper: "The Attack on Brasses by Solder," by Mr. E. L. Rhead. 7 p.m.

The Institution of Electrical Engineers: South Midland Centre, Students' Section.—The University, Edmund-street, Birmingham. "Telephone Transmission through Submarine Cables," by Mr. A. Rosen. 7.30 p.m.

Grantham and District Engineering Society.—Co-operative Hall, Grantham. "Water Supply," by Mr. H. Preston. 7.45 p.m.

Institution of British Foundrymen: Burnley Section.—Technical College, Ormerod-road, Burnley. Paper: "Oil Sand Cores: Methods and Mixtures," by Mr. J. Masters. 7.15 p.m.

Institution of Electrical Engineers: North-Western Centre.—Engineers' Club, Manchester. "The Interconnection of Alternating-current Power Stations," by Messrs. L. J. Romero and J. B. Palmer. 7 p.m.

Royal Society of Arts: Dominions and Colonial Section.—John-street, Adelphi, W.C. 2. "The Timbers of British Columbia," by Mr. Wm. Turnbull. 4.30 p.m.

Institution of Civil Engineers.—Great George-street, S.W. 1. Paper: "Hydro-electric Installations of the Barcelona Traction, Light and Power Company," by Dr. Horace Field Parshall. 6 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. "Variable Stars" (Lecture II.), by Dr. H. H. Turner. 3 p.m.

Institute of Marine Engineers.—The Minories, Tower Hill, E. 1. "The Depths of the Sea," by Captain A. Carpenter. (Ladies' night.) 6.30 p.m.

Institution of Heating and Ventilating Engineers.—Holborn Restaurant (Princes' Salon), High Holborn, London, W.C. 2. Annual general meeting. Presidential address by Mr. A. H. Barker. Paper: "Natural Architecture," by Sir Wm. Bragg, K.B.E. Discussion. 2.30 p.m.

WEDNESDAY, FEBRUARY 8TH.

Thornycroft Engineering Society.—Works Canteen, Basingstoke. "Motor Ship Engines," by Mr. H. P. Purday. 7 p.m.

Association of Engineers-in-Charge.—St. Bride's Institute, Bride-lane, Fleet-street, E.C. 4. Paper: "Some Practical Notes and Observations on Land Type Boilers," by Captain H. J. Wellingham. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. "Some Solved and Unsolved Problems in Gasworks Chemistry," by Mr. E. V. Evans. 8 p.m.

Institute of Costs and Works Accountants.—Hall of the Institute of Chartered Patent Agents, Staple Inn Buildings, Holborn. Lecture: "Hollerith Systems and Machines: Some Applications," by Mr. G. A. E. Green. 7 p.m.

Institution of Automobile Engineers.—Institution of Mechanical Engineers, Storey's-gate, S.W. Paper: "Engine Lubrication," by Mr. E. R. Bass. 8 p.m.

THURSDAY, FEBRUARY 9TH.

Institution of Electrical Engineers: North-Eastern Centre.—Armstrong College, Newcastle. Conversazione. 7.15 p.m.

The Optical Society.—Imperial College of Science and Technology, South Kensington, S.W. 7. Annual general meeting. "The Structure of Abraded Glass Surfaces," by Mr. F. W. Preston; "The Stress Conditions Surrounding a Diamond Cut in Glass," by Messrs. A. J. Dalladay and F. Twyman; a supplementary note on "Achromatic One Radius Doublet Eyepieces," by Lieut.-Colonel J. W. Gifford; note on "Change in Refractive Index at the Surfaces of Glass Melts," by Messrs. F. Twyman and A. J. Dalladay. 7.30 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. "Droughts and Floods" (Lecture II.), by Sir Napier Shaw. 3 p.m.

Institution of Civil Engineers.—Great George-street, S.W. Paper to be read and discussed: "The Design of Modern Water Turbines," by Mr. E. J. Kingston-McCloughry. 6 p.m.

Institute of Metals: London Local Section.—Sir John Cass Technical Institute, Jewry-street, Aldgate, E.C. 3. "Gunmetal," by Mr. R. T. Rolfe. 8 p.m.

FRIDAY, FEBRUARY 10TH.

Institution of Electrical Engineers: Irish Centre.—Royal College of Science, Upper Merrion-street, Dublin. "A Method of Regulating the Voltages on the Two Sides of a Three-wire Continuous-current System Equalised by Static Balancers," by Mr. R. D. Archibald. 8 p.m.

Junior Institution of Engineers.—Caxton Hall, S.W. Questions and general discussion. 8 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Literary and Philosophical Society, Newcastle-on-Tyne. "Shipbuilding Methods," by Mr. John McGovern. 6.30 p.m.

Institution of Locomotive Engineers.—College of Technology, Manchester. Paper: "Steel for Locomotive Purposes," by Sir Henry Fowler. 7 p.m.

Manchester Association of Engineers.—Banquetting Hall, Midland Hotel, Manchester. Smoking concert. 7 p.m.

King's College Engineering Society.—The Institution of Civil Engineers, Great George-street, S.W. 1. Anniversary meeting. 5.30 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. Discourse: "The Teeth of the Nation," by Dr. W. D. Halliburton. 9 p.m.

SATURDAY, FEBRUARY 11TH.

Association of Engineering and Shipbuilding Draughtsmen: Merseyside Branch.—University Engineering Building, Liverpool. "Refrigeration," by Professor J. Wemyss Anderson. 7.30 p.m.

TUESDAY, FEBRUARY 14TH.

Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. (a) "The Production of Lead Pipes by the Extrusion Method," by Mr. John A. Sillars; (b) "The Smelting and Refining of Zinc," by Mr. Howard J. Brand. 7.30 p.m.

Institute of Metals: Birmingham Local Section.—Chamber of Commerce, New-street, Birmingham. "Light Aluminium Alloys," by Professor F. C. Lea. 7.30 p.m.

FRIDAY, FEBRUARY 17TH.

Old Centralians.—Engineers' Club, 39, Coventry-street, W. 1. Annual dinner. 7 p.m.

Junior Institution of Engineers.—Caxton Hall, S.W. "Water Purification for Boiler Feed Purposes," by Mr. W. J. Leaton. 8 p.m.

Institute of Metals: Sheffield Local Section.—Mappin Hall, The University, St. George's-square, Sheffield. "The Mechanical Properties of Metals," by Mr. F. C. A. H. Lantsberry. 7.30 p.m.

TUESDAY, FEBRUARY 21ST.

Institution of Electrical Engineers.—Hotel Cecil, Strand. Annual dinner. 7 for 7.30 p.m.

FRIDAY, FEBRUARY 24TH.

Institution of Locomotive Engineers.—Holborn Restaurant, London. Dinner. 6.30 p.m.

FRIDAY, MARCH 3RD.

British Non-ferrous Metals Research Association.—Queen's Hotel, Birmingham. Annual meeting. 12.50 p.m.

WEDNESDAY AND THURSDAY, MARCH 8TH AND 9TH.

Institute of Metals.—Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual general meeting. 10 a.m. Annual dinner, March 8th, at Trocadero Restaurant, Piccadilly-circus, W. 1. 8 p.m.

WEDNESDAY, MAY 3RD.

Institute of Metals.—Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual May lecture: "The Relation of the Elements," by Sir Ernest Rutherford. 8 p.m.

THURSDAY AND FRIDAY, MAY 4TH AND 5TH.

Iron and Steel Institute.—Institution of Civil Engineers, Great George-street, S.W. 1. Annual meeting. Annual dinner, Thursday, May 4th, at Connaught Rooms, Great Queen-street W.C.